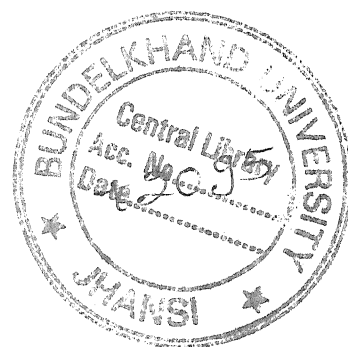


**EFFECT OF PRANAYAMA ON SELECTED PHYSIOLOGICAL  
AND PSYCHOLOGICAL VARIABLES AMONG SCHOOL  
GOING CHILDREN**



**A THESIS**

**Submitted for the Degree of  
Doctor of Philosophy in Physical Education**

**by**

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**2007**




## CERTIFICATE

This is to certify that the work entitled **“EFFECT OF PRANAYAMA ON SELECTED PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES AMONG SCHOOL GOING CHILDREN “** is a piece of research work done by Shri Samay Singh under my guidance and supervision for the Degree of Doctor of Philosophy in Physical Education.

To the best of my knowledge and belief, I further declare that the thesis:

- i) embodies the work of the candidate himself;
- ii) has duly been completed;
- iii) fulfils the requirements of the ordinance relating to the Ph.D. Degree of the University; and
- iv) is up to the standard both in respect of contents and language for being referred to the examiner.

Dated : 4 - 5 - 2007

  
[Dr. (Smt.) Kalpana Sharma ]  
Co-Supervisor



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Dated : 5-5-2007


  
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Supervisor




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I declare that the thesis entitled "EFFECT OF PRANAYAMA ON SELECTED PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES AMONG SCHOOL GOING CHILDREN" is my own work conducted under the Co- supervision of Dr. (Smt.) Kalpana Sharma, Lecturer Department of Education Bundelkhand University, Jhansi (U.P.) INDIA, which was approved by the Research Degree Committee.

I further declare that to the best of my knowledge the thesis does not contain any work which has been submitted for the award of any degree either in this University or in any other University without proper citation.

  
( Dr. (Smt.) Kalpana Sharma )  
Co-supervisor

  
( Samay Singh )  
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## DECLARATION

I declare that the thesis entitled "EFFECT OF PRANAYAMA ON SELECTED PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES AMONG SCHOOL GOING CHILDREN" is my own work conducted under the supervision of Dr. Devraj Yadav, Reader & Head Department of Physical Education, M. M. H. College, Ghaziabad (U.P.) INDIA, which was approved by the Research Degree Committee. I have put in more than 200 days of attendance with the Supervisor.

I further declare that to the best of my knowledge the thesis does not contain any work which has been submitted for the award of any degree either in this University or in any other University without proper citation.

  
(Dr. Devraj Yadav)  
Supervisor

  
( Samay Singh )  
Research Scholar



**Dedicated  
To  
My Father**



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S. S.



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## Chapter – I

### INTRODUCTION

Pranayama, the fourth component of the eight fold pathed of yoga, is the control of 'vital force' or 'cosmic energy', by concentration and regulated breathing. It also signifies life or breath.<sup>1</sup>

Yoga as a recognised vital philosophy, commands belief and one of the first systematic expressions of the metaphysical endeavors of our ancestors. It is a system, which owes its inheritance to the ancient Indians. It indicates a 'life style', aimed towards the training of the physical, mental and emotional aspects of its adherents.

Joshi<sup>2</sup> regards Yoga to be associated with acquisition and exhibition of super natural powers, requiring complete discipline of the mind and the body. He has further explained the word 'Yoga' as the noun form, derived from the root 'yujur', meaning 'to unite' or 'to connect'. Yoga has its own technology and also scientific basis. It is an 'art' which aspires to broaden one's perspective and insight to achieve a state of personal enlightenment.

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<sup>1</sup> Sri Ananda, The Complete Book of Yoga (Delhi : Orient Paper Backs, 1980 ), p. 29.

<sup>2</sup> K.S. Joshi, Yoga and Personality (Allahabad : Udayana Publication, 1967), p. 2.



The prescribed practices and procedures of Yoga, cater to the needs of its adherents under varied conditions, to lead a way of life and attenuate the obstacles in acquiring the state of 'enlightens'. Yoga is also a method of self-realisation which beings with the perfection of one's physical – self and aspires to achieve a state of self - consciousness.

Yoga philosophy holds not only the answer to all man's problems, but also offers a scientific way to transcend his problems and suffering. Moreover, Yoga.

Philosophy does not quarrel with any religion or faith and can be practiced by any one, who is sincere and willing to search for the truth. There is no vague doctrine involved. Even comparatively little effort, will bring immense returns of knowledge, strength and peace<sup>3</sup>.

Most of the knowledge on yoga is in the form of the classical literature of different era and much of it is in Sanskrit language. Though quite distinct, at times the literary style in each era seems to be overlapping. However, it has been observed that the whole system of yoga had its beginning since the time immemorial. It was adopted in various forms and

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<sup>3</sup> Swamy Vishnudevananda, The Complete Illustrated Book of Yoga (New York : Bell Publishing Company, 1959), p. 11



was extensively described by Patanjali,<sup>4</sup> in his 'Yoga Sutras' before it gained a modern outlook of scientific approach.

Yoga has many aspects, and pranayama is one of its most important aspects, which is concerned with breathing exercises. Air (breath) is the most vital source of energy, without which one can not live. Pranayama provides the necessary scope for the oxidation and exchange of gases in the lungs which help in over coming many health hazards. Systematic and frequent rhythmic breathing cures diseases like asthma<sup>5</sup>.

Bhagavad-Gita indicates that pranayama has acquired an independent position, not merely as a psycho-physiological respiratory exercise for rendering the mind, fit for concentration, but also as an independent sacrificial act, leading to the realization of super natural beliefs and understanding<sup>6</sup>.

Suryabhedana and Shitali pranayama practices described by some of the authors are as follows:

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<sup>4</sup> Swami Satya Prakash Saraswati, Patanjali Raja Yoga (New Delhi): S. Chand & Co., 1975), pp. 316-329.

<sup>5</sup> Andre Van Lysebeth, Yoga Self Taught, Trans. By Carola Congreve (New York : Barnes & Nobel Books, 1968-71), p. 22.

<sup>6</sup> Swami Kuvalayananda, ed., "Pranayama in Bhavadgita," Yog Mimansa VI (June 1956) : 65.



### **Suryabhedan Pranayama:**

Surya nadi is the right nostril. It is used in this pranayama for a puraka in every round. This fact has significance in giving this variety its name. The left nostril is tried every time for rechaka. The Suryabhedana may be called onesided Anuloma-viloma. Kumbhaka is done between the puraka and rechaka<sup>7</sup>.

### **The Technique of Suryabhedana Pranayama:**

First of all the student of Yoga should arrange or a comfortable seat which he can continue to sit for a long time without any uneven pressure on his folded legs and hips which might cause discomfort. Then he should assume any meditative pose such as Padmasana or Siddhasana to which he may be accustomed. When he is thus seated, he should slowly inhale external air through the right nostril and retain it till he feels the pressure all over his body right upto the hair and upto the end of his nails.' Here it is to be noted that the student should consult his own capacity to begin with the develop his Kumbhaka gradually step by step. Haste in this respect is likely to damage the lungs and may lead even to some incurable diseases. The

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<sup>7</sup> Ganesh Shanker, "Holistic Health by Yogic Practices" Published in Psychotherapy, Yoga and Traditional Therapies of East and West (Delhi: Lakhera Off set Printers, 2004) p.318.



Sanskṛta text does not mention here the formation of the three Bandhas, as they are common to all the types of Pranayama and have been stated in H. P. 11-45 and 46. But we could strongly advise the students of Yoga to practice their Pranayama only with Jalandhara Bandh and avoid Uddiyana and Mula at least in the first stages of Abhyasa. Even afterwards the full practice of Bandhas should be undertaken only under the guidance of a competent master. Jalandhara is particularly prescribed in this Pranayama, in Gheranda-Samhita, V- 58. After holding the breath to capacity, the inhaled air is to be exhaled through the left nostril much more slowly than at the rate followed at the time of inhalation. Puraka, Kumbhaka and Recaka will form one round of Suryabhedana. These rounds are to be repeated successively at one sitting according to the capacity of the individual. The questions of the manipulation of the nostrils, the time to be given respectively to Puraka, Kumbhaka and Recaka etc., have been discussed at the relevant places.<sup>8</sup>

### **Shitali Pranayama:**

In it the puraka is done through the mouth. The two sides of the tongue are turned up to give it the form of a channel. The tip of the tongue is drawn out of the mouth and air is inhaled over this passage. Then the mouth

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<sup>8</sup> Ibid. p. 89.



is closed and kumbhaka is performed, followed by a rechaka through both the nostrils. This variety is useful to combat the effects of heat in summer.<sup>9</sup>

### **The Technique of Shitali Pranayama :**

The lines from H. P. quoted above do not explain the whole technique. But the tradition is very clear in this regard and the commentary Jyotsna leaves us in no doubt, so also Siva Samhita, 111-84 quoted at the end here. The practice of this Pranayama starts with putting forth the tongue about 3/4 of an inch outside the lips. When this is done the tongue is to be folded double lengthwise, both inside and outside the mouth, so as to form a sort of a channel almost making a tube like formation below the upper lip. The outer end of the tongue will naturally form a narrower channel sloping towards the tip of the tongue. When thus arranged the tongue assumes the form of the lower part of a bird's beak. This lingual channel is to be used for inhaling air from outside at the time Puraka. Inhalation over, the tongue is to be withdrawn and lips are to be closed. Kumbhaka is of the usual type. Recaka is to be performed slowly as in other cases, but through both the nostrils at the same time. In explaining the name of this Pranayama we have stated that it is due to the cooling effect of it on the body. This effect is due

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<sup>9</sup> Ibid. p. 318.



to the air being sucked up through the mouth and not through the nose. Physiologically the nose is intended not only for breathing but also for warming up the external cool air before it enters the lungs. What is taken for granted in this Pranayama is that the external air is neither above body temperature nor far below it. Hotter air will fail to give the cooling effect. If the air is far below the body temperature it may affect the lungs adversely. Shitali is to be practiced in hot season inside a cool cell in an Asana<sup>10</sup>.

### **Statement of the Problem**

The purpose of this study was to determine the effects of Pranayama practice on selected physiological and psychological variables.

### **Delimitations**

1. The study was delimited to the students of Khalsa School, Bulandshahr (U.P.), in the age ranging from 10-15 years.
2. Study was further delimited to the following physiological and psychological variables:

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<sup>10</sup> Swami Kuvalayananda, "Pranayama" (Pune : ACE Enterprises, 2000) p. 93-94.



### Physiological Variables

- [a] Resting Heart Rate
- [b] Resting Blood Pressure
- [c] Vital Capacity
- [d] Resting Respiratory Rate
- [e] Maximum Breathe Holding Time
- [f] Air-flow Rate
- [g] Cardio –vascular Efficiency
- [h] Hemoglobin Percentage

### Psychological Variables

- [a] State Anxiety
- [b] Cognitive Anxiety
- [c] Sports Self Confidence
- [d] Locus of Control
- [e] Concentration

3. The following Pranayama were again delimitation of the study.

- a) Suryabhedana
- b) Shitali



### Limitations

1. Non availability of sophisticated instrument was considered as limitation of this study.
2. Rest, sleep, exercises and dietary habits were again limitations of this study.

### Hypothesis

It was hypothesised that there may not be significant effect of eight week pranayama practice on selected physiological and psychological variables.

### Definition and Explanation of the Terms

#### **Pranayama**

Pranayama means a regulation and restraint of breath, the fourth limb of Astanga Yoga.



### Significance of the Study

- 1- Result of this study will help as the basis in the training methods applicable to the athletes and the player in the various games and sports.
- 2- Study of pranayama practice will be helpful for the development of general health and physical efficiency of sports person.
- 3- Result of this study will be helpful for the physical education teachers, coaches and athletes for the enhancement of knowledge of Yoga.
- 4- Study will be beneficial for remedial, curative and rehabilitative programmes for people suffering from respiratory problems.



## Chapter – II

### REVIEW OF RELATED LITERATURE

Research scholar made sincere efforts to review the related literature pertaining to pranayama, Physiological and Psychological variables available at library of the Lakshmibai National Institute of Physical Education, Gwalior and some of the important studies are cited below:

According to Vasu<sup>1</sup> Pranayama is meant to restrain the inspiration and expiration and are regarded synonymies with breath or life. The heart is the principal organ which by propelling the blood through the arteries and keep up human life. Action of heart being involuntary to be influenced, one must act through the lungs, In other words through the 'breathe'.

According to Svatmarama<sup>2</sup> Pranayama of low degree of merit generates heart , that of an intervention degree, throbbing , Cortaid blissful position is achieved in which it is easy for 'prana' to rise to the highest central point of brain. Hence one should train one self in respiration by practicing Pranayama. One should rub over the body, pre respiration if any,

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<sup>1</sup> Rai Bahadur Srisa Chandra Vasu, An Introduction to the Yoga Philosophy (New Delhi : Orient Book Reprint Corporation, 1975), pp. 37-44.

<sup>2</sup> Svatmarama Suri, Hathapradipika ed. Swami Digambarji and Raghunatha Shastri Kokaji (Lonavla) Kaivalayadhama S.M.Y.M. Samiti, 1970), pp.41-52.



caused by exertion due to Pranayama .By doing this the body attains strength and lightness.

According to Kuvalayananda<sup>3</sup> Pranyama (for physical culturist), should be practiced in a well ventilated place, avoiding exposure to drought and it is not essential to adopt any pose. Physical culturist can practice Pranyama will sitting, or while standing or even while walking.

Rai<sup>4</sup> has described the meaning of Pranayama, considering Puraka [filling]; Recaka {expelling and Kumbhaka [confing].Accordingly Kumbhaka is described to be of two kinds, namely Sahita [with] and Kevala [alone]. Exercise in Sahita is to be continued till success in Kevala is gained. This letter is simply confining the air with ease, without recaka and purka. This unassisted Kumbhaka is Pranayama par excellence. When it can be performed without puraka and recaka, there is said to be nothing in the three worlds which is difficult to be obtained.

Joshi<sup>5</sup> advocated the practice of Pranayama in a progressive manner, so that inhalation is half the time of exhalation. After practicing puraka and

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<sup>3</sup> Swami Kuvalayananda, ed. Yoga Mimamsa III (July-October, 1928) : 258-272.

<sup>4</sup> Ram Kumar Rai, Encyclopaedia for Yoga, 1975.

<sup>5</sup> K.S. Joshi, Yoga and Personality (Allahabad :Udayana Publication,1957), pp.142-154.



recaka twenty times in the ratio of 10:20 seconds. Kumbhaka [retention of breath, after inhalation] is practiced. Joshi further states that a Pranayamic does, sufficient to maintain good health would consist of Puraka: 10 seconds, Recaka 20 seconds, Kumbhaka: 15 seconds. Practiced 20 times in 115 minutes on an average.

Sivananda<sup>6</sup> spoke of Pranayama in terms of Prana and discussed its various types and methods in great details. According to him there are three types of Pranayama, namely Adhama, Madhyama and Uttama [inferior, medium and superior]. The Adhama Pranayama consists of 12 mantras; Madhayama, consist of 24 mantras [this is for puraka]. The ratio between puraka, kumbhaka and recaka is 1:4:2. It is suggested to practice Adhama for a month, then pratice Madhayama for three months and then take up the uttama variety.

Kuvalayananda<sup>7</sup> describe the suryabhedana as a comfortable yogic pose is assessed breathing-in the internal air slowly, through the right nostril, and is held, in till the pressure is felt upto the hair (on the body and upto the tips of the nails). After this stage, the air is exhaled through the left nostril.

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<sup>6</sup>Swami Sivananda, The Science of Pranayama (Tehri -Garhwal : Devine Life Society, 1935-67), pp.69-70

<sup>7</sup> Swami Kuvalayananda, Pranayama (Bombay : Popular Pakashan, 1966), p.6.



This process is repeated several times. In Hatha-Yoga literature 'Surya' means the right end 'Chandra' means the left. Suryabhedana means that pranayama which is used for the awakening of the "Kundalini" and in which inhalation is made through the right nostril.

The difference between pranayama in "Yoga Sutra" and "Vyasa Bhusa" are mentioned as follows:<sup>8</sup>

Patanjala Sutra (PS), and Vyasa Bhusa (VB)

1. PS: Pranayama is a pose in the movement of inhalation and exhalation when that (Asanas) is secured.

VB: Pranayama is the pose in the movement resulting in cessation of both.

2. PS: Pranayama is external, internal and stand- still. When examined in units of time, space and number, it becomes prolonged and light.

VB: Pranayama is external where the pose comes after exhalation.

It is internal where the pose comes ten seconds:, ten seconds, going

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<sup>8</sup>Idem, Pranayama Part II (Lonavla : Kaivalyadhama, 1958), pp 26-29.



upto 8:16:16 seconds, of Puraka, Kumbhaka and Recaka, respectively.<sup>9</sup>

Rai<sup>10</sup> describes the method of performing pranayama as follows :  
Padmasana posture : Airs filled in through left nostril (closing the right one); keeping it confined according to one's ability it is expelled slowly through the right nostril ;Then drawing-in the air through the right nostril slowly , the belly is filled and after performing kumbhaka as explained before ,it is expelled slowly through the left nostril , Inhaling through the one , which it was expelled , one having restrained it till possible , it is exhaled through the other , slowly and not forcibly . If the air is inhaled through the left nostril , it is expelled again through the right ; then filling it through the right nostril and confining it; is expelled through the left nostril.

The proposed ratio of performing puraka , kumbhaka and recoka is 1 ; 4; 2 ; and the time unit is fixed according to one;s convanience ;kumbhaka ia performed gradually.

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<sup>9</sup> Swami Vishnudevananda, The Complete Illustrated Book of Yoga (New York: The Julion Press, Inc. Publishers, 1961),

<sup>10</sup> Ramkumar Rai, p.162.



Bhole<sup>11</sup> has mentioned that pranayama plays an important role in the development of the respiratory system, and out of many automatic functions in the body, it is only the respiratory activity which goes on continuously and which is partially under our control, involving a good number of skeletal muscles. It also influences very many automatic functions like the activity of the heart, circulation and digestion, directly as well as indirectly. Naturally then, any control of respiration is likely to have a far reaching effect on the whole psycho-physiological system. From the oldest times it has been claimed that pranayama leads to the eradication of the flows of psycho-physiological reactivity.

Prabhavananda,<sup>12</sup> describes pranayama as the second subtle sheath next to "annanaya", the food body. Prana is a vital principle, the force which vitalizes and holds together the body and the mind. It pervades the whole mechanism and its gross manifestation is breath. Since to the unmeditative man, no peace will come. Gita, puts emphasis upon the practice of meditation, technically known as raja yoga, which is an eight fold path consisting of yana (moral discipline): asana (posture): pranayama

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<sup>11</sup> M.V. Bhole, "Pranayama and its Rationale" Yog Mimansa VIII (January, 1966) : 10-28.

<sup>12</sup> Swami Prabhavananda, The Spiritual Heritage of India (London : George Allen and Unwin, 1972), pp. 53-252.



(breathing exercises): Pratyahara (releasing the mind from the thralldom of senses): dharana (concentration): dhyana (meditation): and samadhi (the superconscious state). Prabhavananda further describes pranayama to be the forth limb of yoga, and it controls the vital energy of the life principle. It is the energy that enables us to act, think and breath and Pranayama is the indirectly. Naturally then any control of respiration is likely to have a far reaching effect on the whole psycho-physiological system.

According to Taimni<sup>13</sup> Pranayama has an important role to play in the technique of Yoga, due to its close relationship between Prana and wind. Prana is a vital force which keeps the activities of the physical body. The beneficial effects of pranayama depend upon the increased intake of oxygen.

Yogendra,<sup>14</sup> conducted name specialized studies on yoga in psychology, physiology and sociology and experienced some inconvenience in relation to proper laboratory facilities, scientific methods and bonafide subjects, as well as lack of comprehensive hypothesis. He pointed out that among other tests. Searching Ph. Value of urine after Pranayama are the

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<sup>13</sup> I.K. Taimni, Science of yoga (Madras : Theosophical Publishing House, 1965), pp. 258- 263.

<sup>14</sup> Shri Yogendra, Yoga in Modern Life (Bombay : International, 1966), p. 195.



types of researches undertaken on a system that aspires for psycho-somatic discipline and spiritual consciousness.

Vishnudevananda,<sup>15</sup> speaks of Yogic breathing as an attempt to control the physical manifestation of Prana in the physical body. Five principal prana's being: Prana, apana, samana, udana and vyana. The seat of Prana is heart; of apana is the anus; and of samana is the region of the navel; of udana, is the throat; and of vyana is all pervading, moving all over the body. The colour of prana is red gem; and its function is respiration. Apana does excretion and its colour is between that of pure milk and crystal. Udana does deglutition (swallowing of food) and is plain white in colour. Vyana also assumes the function that takes one to sleep. Vyana performs circulation of blood and it resembles the colour of archil (ray of light). These five pranas function through the five subsidiary nerve centers in the brain and spinal cord.

Kuvalayananda,<sup>16</sup> mentions the following hints for practical students of yoga, who practice pranayama.

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<sup>15</sup> Swami Vishnudevananda, The Complete Illustrated Book of yoga, pp.222-244.

<sup>16</sup> Swami Kuvalayananda, ed. Yoga Mimamsa VI (March, 1957) : 300.



- (a) The ultimate aim of yoga (pranayama) is to awaken the kundalini and with its currents to force open the six chakras and the three granthis.
- (b) A beginner should practice only Puraka and Recaka, making the latter double in duration than the former. These should be limited to capacity which may be gradually developed. Kumbhaka should be introduced cautiously, at a later state.
- (c) Prescribed technique with right hand over the nose bridge should be used while inhaling and exhaling through the nostrils in Pranayama.
- (d) The practice of Pranayama will yield best results, if it is practiced with concentration and in a meditative pose.
- (e) Pranayama should always be practiced with an empty stomach and preferably after bath.
- (f) The Pranayama should be soft and comfortable, so that it may not interfere with concentration.
- (g) The place of Pranayama practice should be well ventilated, but body should not be exposed to a heavy draught.



Kuvalayananda<sup>17</sup> conducted an experiment to examine the effects of prolongs pranayamic exercise on urine excretion using Bhastrika pranayama. The observations indicated that prolonged pranayamic exercises (Bhastrika) does not lead to an increase in urine acidity.

Bhole and Karmbelker<sup>18</sup> measured vital capacity in two groups at 24 males mach, and trained them for three weeks. The result should be significant increase in vital capacity after Yogic training in the experimental group when compared control group.

Johnson and Buskirke<sup>19</sup> mentioned about the changes in the respiratory responses to exercise during training. The changes were progressive and four to six weeks were regarded as adequate to reach maximum efficiency. Changes in pulmonary ventilation for minute were associated with a decrease in rate and an increase in depth of breathing (increased vital capacity). In the trained subjects, even at rest the depth of breathing was found to be greater and the respiratory rate showed a decrease from even twenty to about eight breaths per minute.

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<sup>17</sup> Swami Kuvalayananda, "Experiment on Pranayama," Yoga Mimansa VI (June, 1956) : 9-20.

<sup>18</sup> M.V. Bhole and P.V. Karmbelkar, "Effect of Yoga Practices on Vital capacity" Indian Journal of Chest Diseases XIII ; ( 1974) : 1-4.

<sup>19</sup> Luciem Brouna, ed. By warren R. Johnson and E . R .Buskirke, Science and Medicines of Exercise and Sports (New york :Harper and Row Publishers,1973), pp. 279-280.



Wenger, Bagchi and Anand<sup>20</sup> investigated on four Yoga practitioners in relation to pulse and heart. Two practitioners claimed to stop the heart ; one formerly made this claim but only demonstrated his method ; the fourth claimed only to slow the heart. The method for the first three was similar, as it involved retention of breath and considerable muscular tension in the abdomen and thorax, with closed glottis. It was concluded that venous return to the heart was retarded but that the heart was not stopped, although heart and radial pulse rounds weakened or disapproved the fourth subject, with different intervening mechanisms, also presumably under striated muscle control, did markedly slow his heart. The results indicated a strong increase in vegal tone of unknown origin.

Pratap, Berettini and Smith,<sup>21</sup> observed that the reduction in minute ventilation during pranayama involving slow rate of breathing, does not effect the effective alveolar and blood gas composition. On the other hand, the faster breathing of Kapalbhati producers some reduction in carbon-di-oxide in the alveolar air without producing any respiratory alkalosis.

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<sup>20</sup> M. A. Venger and B. K. Bagchi, "Studies of Autonomic Functions in Practitioners of Yoga in India" Behavioral Science 6 ( 1961) : 312-323.

<sup>21</sup> V. Pratap, W. H. Berrettine and G . Smith "Arterial Blood Gases in Pranayama Practices ", Perceptual Motor Skills 46 (I) (1978): 171-174.



According to Gharote,<sup>22</sup> Cardio-vascular fitness plays a vital role in the maintenance of proper health and physical fitness. The purpose was to determine the effects of long term yogic training program on Cardio-vascular efficiency Harvard step test was administered on eleven male students and the results of the study indicated that on hour of daily yogic exercises including pranayama schedule, significantly improve Cardio-vascular efficiency of the students.

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<sup>22</sup> M. L. Gharote and S.K. Ganguly " Effect of Yogic Training on Physical Fitness" Yoga Mimansa XV ( Jan.,1973) : 31-35.



## **Chapter – III**

### **PROCEDURE**

In this chapter selection of subjects, selections of variables, reliability of data, experimental design, collection of data and statistical technique for analysing data have been mentioned.

#### **Selection of Subjects**

The subjects for this study were ninety (90) male students of Khalsa School, Bulandshahr (U.P.) in the age ranging from 10-15 years. All the subjects were divided into three different group's i.e. two experimental groups and one control group.

#### **Selection of Variables**

On the basis of review of related literature, expert's opinion in the field of Yoga, exercise physiology, Sports psychology, and scholar's own understanding, following physiological and psychology variables were selected for the purpose of this study.



### **Physiological Variables**

- [a] Resting Heart Rate
- [b] Resting Blood Pressure
- [c] Vital Capacity Resting
- [d] Respiratory Rate
- [e] Maximum Breathe Holding Time
- [f] Air-flow Rate
- [g] Cardio -vascular Efficiency
- [h] Hemoglobin Percentage

### **Psychological Variables**

- [a] State Anxiety
- [b] Cognitive Anxiety
- [c] Sports Self Confidence
- [d] Locus of Control
- [e] Concentration



### **Reliability of Data**

The reliability of data was ensured by establishing the instrument reliability, tester competency and reliability of the test and subject reliability.

#### **Instrument Reliability**

All the instruments used were available in Human Physiology Laboratory of the Lakshmibai National Institute of Physical Education, Gwalior and their calibrations were accepted was accurate enough for the purpose of this study.

#### **Tester Competency**

To ensure that the investigator was well versed with the techniques of conducting the tests, the investigator had a number of practice sessions in testing procedure under the expert's and assistant's supervision. All the assistants had training and a period of practice before conducting the test.

Tester's competency was established by test-retest method whereas consistency of result was obtained by product moment correlation. The data by test-retest process were computed for each variable and are presented in Table-1:



**TABLE - 1**  
**RELIABILITY COEFFICIENT OF TEST- RETEST SCORES**

S. No.	Variables	Co-efficient of Correlation
1	Resting Heart Rate	.95*
2	Resting Blood Pressure	.921*
3	Vital Capacity	.91*
4	Resting Respiratory Rate	.94*
5	Maximum Breath Holding Time	.95*
6	Air-flow Rate	.905*
7	Cardio Vascular Efficiency	.931*
8	Hemoglobin Percentage	.903*
9	Concentration	.902*

\*Significant at .01 level

### Experimental Design

Subjects selected for this study were divided into two experimental group and one control group according to random group design.



### **Collection of Data**

The data on Physiological variables was collected by administering following standard procedures:

#### **Resting Pulse Rate**

Resting heart rate was recorded while the subject was in supine position. The subjects were instructed to be in supine position for at least 15 to 20 minutes before recording to resting pulse rate. Then the research scholar kept his finger tips on the radial artery of the subject and the pulse beats were palpated for 15 seconds for each subject and finally it was converted in minute's form (B/M). The resting pulse rate was recorded in terms of number of pulse per minute.

#### **Resting Blood Pressure**

A sphygmomanometer (dial type) and a stethoscope were used to measure blood pressure (systolic and diastolic). The subject was placed in a supine lying position for 15 to 20 minutes for recovery from any unusual tension.



The left upper arm of the subject was encircled by an inflatable rubber bag containing in cuff was connected to pressure pump and manometer. By pumping air to pressure in the bag was rapidly raised to 180 mm Hg, which was sufficient to obliterate completely the brachial pulse, disappeared. The pressure was then lowered to a point where the pulse could be felt by using a stethoscope; the pulsation of the brachial artery at the bend of the elbow could be distinctly heard. At this point the pressure shown on the deal was recorded as systolic pressure.

The pressure on the brachial artery was then gradually reduced until the arterial pulse beats could by distinctly heard and the point at which the sound disappeared was recorded as diastolic pressure.

### **Vital Capacity**

Vital capacity was measured in ml. by using dry spirometer. The spirometer was brought in to zero position. The subject performed maximum inspiration and after closing the nose, the air was blown as intensely as



possible in the mouth piece. Then the amount of expired air was read directly from the calibrated scale and that was the score of vital capacity.<sup>1</sup>

### **Resting Respiratory Rate**

Resting respiratory rate was recorded while the subject was in supine position. The subjects were instructed to be in supine position for 15 to 20 minutes before recording the resting respiratory rate. Then the research scholar kept his palm just below the thoracic cavity that is on the diaphragm of the subject and was palpated for 60 seconds for each subject. The resting respiratory rate was recorded in term of the total number of inhalation and exhalation per minute.

### **Maximum Breath Holding Time**

To measure the maximum breath holding capacity, the subjects were instructed to place the nose lip tightly. They will be asked to inhale through the mouth to the maximum capacity. As soon as the subjects took a deep breath to the fullest capacity of their tags and close the lips, the stop watch was started. As soon as the subjects opened their lips to exhale, the stop

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<sup>1</sup> Johanne Reh, Introduction into Sports Biology. (Leipzig: German College for Physical Mm, 1972), p. 161.



watch was topped and the time given by the watch was recorded as the score of maximum breath holding capacity.

### **Air-flow Rate**

The air flow rate of the subjects was recorded with the help of air flow meter. The instrument has a detachable mouth piece connected to a small plastic drum which has a graduate dial with marking ranging from 0 -100 (one liter). The dial has also an indicator which revolves when air blows into a small plastic drum like apparatus. When the indicator comes to rest at point along the graduate dial. The reading on the dial shows the air flow rate in liters/ minute. After noting down the reading the dial is rotated clockwise, so that indicator points to zero again<sup>2</sup>.

### **Cardio-Vascular Efficiency**

The cardio- vascular efficiency was measured especially in relation to the pulse at rest, after exercise and after rest following the exercise through the physically efficiency index obtained by the administration of Harward

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<sup>2</sup> Tejinder Singh Brar, (Unpublished Ph.D. Dissertation, Jiwaji University, Gwalior, 1982) pp. 65-68.



Step Test in which a wooden platform of 20 inches height, stop watch, metronome and stethoscope were used as equipment.

To administer the test, each subject was asked to stand near the 20 inches high platform. On the command "Ready" "Start" the subject stepping up and down to bench to a four count rhythm which is explained as follows. On count one the subject stepped on the bench with one foot, on count "two" the subject lifted the body up straightening the leg already placed on the bench and placed the second foot also on the bench, keeping the trunk upright. On count "three" the subject placed one foot on the floor, and on count "four" the other foot also brought down to the floor. The subject was allowed to lead off with either foot or to change the leading foot during the rest. The subject was permitted to step up with a jump and as instructed to extend the knee fully when both the feet were on the bench or the floor. The four count rhythm was maintained with the help of metronome. The stepping exercise continued for a maximum five minutes at the rate of 30 steps per minute, unless the subject was forced to stop because of exhaustion. In either case, the duration of exercise was recorded in seconds, 300 seconds being the maximum. Immediately after the stepping exercise, the subject was asked to rest in a chair and after one minute the tester recorded the pulse rate



of the subject for the duration of 30 seconds. Pulse was counted by using stethoscope, placing it on the left hand side of the chest where heart is situated.

The final score of each subject was calculated in terms of physical efficiency index by the following formula.<sup>3</sup>

$$\text{P. E.I.} = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{Sum of pulse counts in recovery}}$$

### Hemoglobin Percentage

Hemoglobin percentage was assessed with the help of hemometer manufactured by superior company of West Germany.

The data on psychological variables was collected by administering following standard tests:

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<sup>3</sup> Lucien Brouha, Norman Co. Fradd and Beatrice M. Savage, "Studies in Physical Efficiency of College Students" Research Quarterly 15:3 (Oct. 1944).p.211.



### 1. State Anxiety:

To measure state anxiety the questionnaire developed by Tiwari and Pal was used. The subject of all the group concerned were assembled in the class room of Khalsa school Bulandshahar (U.P.) and they were explained the purpose of the test. The subject were distributed the State Anxiety questionnaire. The directions were read by the researcher at the dictation speed to make the subject understand what they were exactly required to do. The inventory had no time limit but on an average it required about ten minutes for responding the fifteen questions.

The State Anxiety had thirty items. The subjects were instructed to respond to each item accordingly to how he generally feels in competitive sports situations. Every statement had three possible responses, namely, (a) always (b) some times, (c) never.

While the subject were responding to the questionnaire the scholar went around verifying that they were recording answers sequentially and the explained the meaning of the words to the subjects in case of doubt.

The completed questionnaires were scrutinized by the scholar in order to ensure that the subjects had responded to every item without leaving any one of them unanswered. The items were worded in such a manner that they



were scored according to the following key: Score 3, 2, 1 for each positive answer and 1, 2, 3 for each negative answer respectively. Total of all the answer as per key system constitute final score.

## **2. Cognitive Anxiety:**

Cognitive anxiety was measured with the help of cognitive anxiety questionnaire by Harish and Mahesh Bhargawa and associate. The subject of all the group concerned were assembled in the class room of Khalsa school Bulandshahar (U.P.) and they were explained the purpose of the test. The subject were distributed the questionnaire. The directions were read by the researcher at the dictation speed to make the subject understand what they were exactly required to do. The inventory had no time limit but on an average it required about thirty minutes for responding the ninety questions.

While the subject were responding to the questionnaire the scholar went around verifying that they were recording answers sequentially and the explained the meaning of the words to the subjects in case of doubt.

All the questions were answered in yes/no form however only yes answer were counted and recorded for the purpose of Analysis.



### 3. Sport Self Confidence

Sport self confidence was measured by the sport self confidence (state and trial) inventory prepared by the Vealy<sup>4</sup>. The inventory had two parts, that is trial sports self confidence and state sports self confidence and each part had 13 questions. In front of each questions point from 1 to 9 were written. The student had to read the questions and circle the appropriate number according to the degree of weight age one feels about the questions.

All the subjects were assembled in the Khalsa Mont. Sr. Sec. School, Bulandshahr (U.P.) and they were explained the purpose of the test. The subject were distributed the questionnaire. The directions were read by the scholar at a dictation speed to make the subjects under stand what they were required to do. The inventory had no time limit but on an average it required 20 minutes on the part of subject to complete the for inventory, what is, state and trial. While the subjects were responding to the questions the scholar went around verifying that they were recording answers properly.

Both the inventories were scrutinized by the scholar in order to ensure that no question was left unanswered. The total score of the subject was the

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<sup>4</sup> Robin S. Vealy, "Conceptualization of Sport Confidence and Competitive Orientation", Journal of Sports Psychology 8 (1986) : 244.



addition of numbers circled by him. The maximum score was 117 and the minimum 13.

#### 4. Locus of Control

The Locus of Control was measured by the Rotter's locus of control scale prepared by Kumar and Shrivastava<sup>5</sup>. All the subjects were assembled in the class room of the Khalsa Mont. Sr. Sec. School, Bulandshahr (U.P.) and they were explained the purpose of this test. The subjects were distributed the questionnaire. The directions were read by the researcher at the dictation speed to make the subject understand what they were exactly required to do. The scale had no time limit but on an average it required about 25 minutes for responding to the 29 items.

The scale had 29 items each item had two parts what is, A and B and the subject had to tick either A or B according to his or her choice. There were six filler items, namely, 1, 8, 14, 19, 24 and 27, which were not scored. While the subjects were responding to the questions, the scholar went around verifying that they were according to answers sequentially, and explained the meaning of the words in case of doubt.

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<sup>5</sup> Anand Kumar and S.N. Shrivastava, Rotter's Locus of Control Scale (Kumar Publication: Kali Mahal, Varanasi, 1985, p. 7).



The completed questionnaire was scrutinized by the scholar in order to ensure that no question was left unanswered the item numbers 1, 8, 14, 19, 24 and 27.

Being filler questions were not scored. For the item numbers 2, 6, 7, 9, 16, 17, 18, 20, 21, 23, 25 and 29 one point was given to those subjects who tick 'A' part. For item numbers 3, 4, 5, 10, 11, 13, 15, 22, 26 and 28 one point was given to those subjects who tick 'B' part. The maximum possible score on Rotter's locus of control scale was 23 and minimum zero.

### **5. Concentration:**

#### **Purpose :**

Concentration purpose to measure the concentration ability of the subjects.

#### **Equipment :**

Electrical mirror drawing apparatus by national psychological corporation, Agra.

#### **Procedure :**

A calm and quite atmosphere, as required to conduct this test was provided. The subject was asked to sit on front of the mirror drawing apparatus. The rubber pin having thin rod was given to the subject and was



placed at the starting point in the star. The wooden plate was adjusted horizontally at adequate height above the hand of the subject so that start task was not directly visible to the subject. The subject was told to move the pin in such a manner so that it does not touch the outer part of the smaller and bigger star and subject was also instructed to concentration in to the mirror while performing star task with his hand. For each trial total number of errors and total time taken to complete each trial was recorded and in similar way they were given three trials and the average of total time and errors for each individual was calculated.

Each subject was given two trials in order to make them familiar with apparatus.

#### **Scoring :**

The total number of errors were those when the iron rod touched with either outer parts of the smaller and bigger star and this was recorded in the meter recording number of errors. The stop watch was started as the command was given and stopped as the subject completed the star task, the total time taken to complete the star task, the total time taken to complete the task was recorded.



The average of three trials was recorded in order to obtain reliable score as three trials in each case considered to be sufficient to yield reliable scores.

### Analysis of Data

To find out the effect of Suryabhedana and Shitali pranayama on selected physiological and psychological variables, Analysis of Co-variance (ANCOVA) was employed at 0.05 levels.



## Chapter – IV

### ANALYSIS OF DATA AND RESULTS OF THE STUDY

The statistical analysis of data collected on ninety subjects belonging to three groups i.e. two experimental and one control to find out the effect of Suryabhedana and Shitali Pranayama's on selected physiological and Psychological variables have been presented in this chapter.

The subjects were divided into three equal groups consisting of thirty subjects, each belonging to two experimental and one control group i.e. A, B and C. Group A was exposed to Suryabhedana Pranayama, group B was exposed to Shitali Pranayama and Control group C was not exposed to any Pranayama. Practice. Experimental groups practiced for eight-week training.

To find out the effect of Suryabhedana and Shitali pranayama on selected physiological and psychological variables, Analysis of Co-Variance was used and results pertaining to these have been presented in tabular form from table 2 – 26 and figure 1 - 14.



TABLE - 2

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN  
RESTING PULSE RATE**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F-Ratio
	A	B	C					
PRE TEST MEANS	73.93	74.13	76.33	A	2	106.4	53.20	0.252
				W	87	3308	38.02	
POST TEST MEANS	69.53	67.13	74.70	A	2	897.09	448.54	18.47*
				W	87	2113.23	24.29	
ADJUSTED POST TEST MEANS	70.15	67.58	73.67	A	2	548.20	274.10	37.78*
				W	86	624.02	7.26	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 2 that the analysis of covariance for the subjects in resting pulse rate indicated that the resultant F-ratio of 0.252 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 18.47 which was higher than the pre test means which was significant at .05 level of confidence, similarly the obtained values of F- ratio 37.78 of adjusted post means was significant at the chosen level.



TABLE – 3

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN RESTING PULSE RATE**

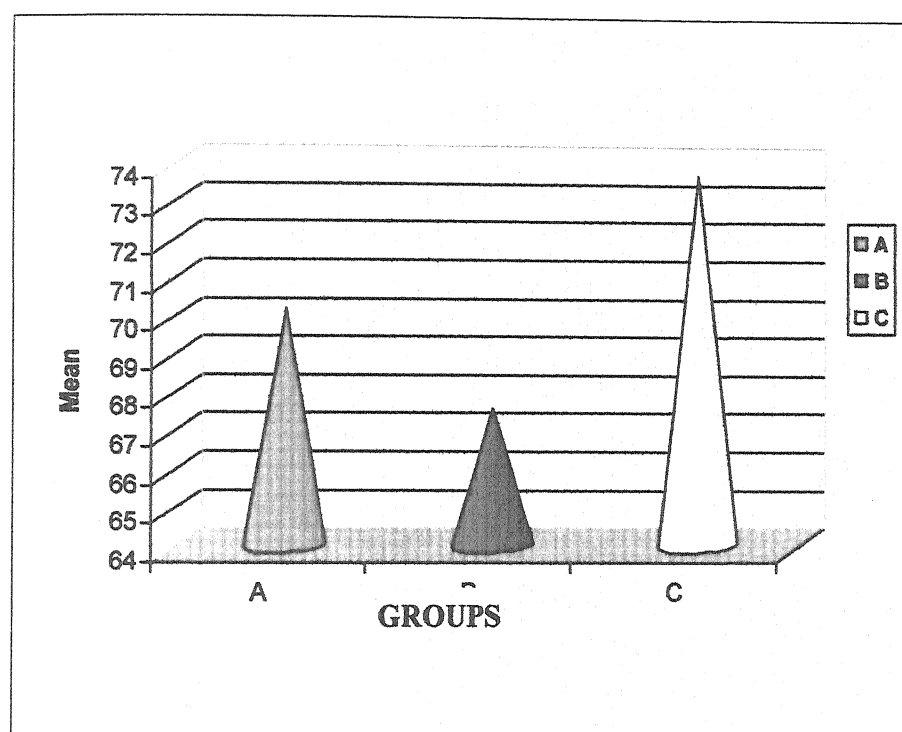
GROUPS			Mean Difference	Critical Difference
A	B	C		
70.15	67.58		2.57*	0.795
70.15		73.67	3.52*	
	67.58	73.67	6.09*	

\*Significant at .05 Level.

It is evident from table – 3 that significant difference was found between group A and group B; between group A and group C; and group B and group C.



**Fig.-1 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN RESTING PULSE RATE**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 4

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN RESTING  
DIASTOLIC BLOOD PRESSURE**

	GROUPS			Df		Sum of Squares	Means Sum of Squares	F-Ratio
	A	B	C					
PRE TEST MEANS	85.00	86.90	83.03	A	2	224.29	112.14	8.745*
				W	87	1115.67	12.82	
POST TEST MEANS	85.03	86.77	82.80	A	2	238.47	119.23	8.992*
				W	87	1153.63	13.26	
ADJUSTED POST TEST MEANS	85.11	85.11	84.47	A	2	7.56	3.679	.948
				W	86	333.59	3.879	

\*Significant at .05 level

A = Among the Groups

N = 90

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 4 that the analysis of covariance for the subjects in resting diastolic blood pressure indicated that the resultant F-ratio of 8.745 was significant in case of pre-test means which shows that pre test means differ significantly. The post test means of both group indicated F-ratio of 8.992 which was higher than the pre test means and was significant at .05 level of confidence but the obtained values of F-ratio 0.948 of adjusted post means was insignificant at the chosen level.



TABLE - 5

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN RESTING DIASTOLIC BLOOD PRESSURE**

GROUPS			Mean Difference	Critical Difference
A	B	C		
85.11	85.11		0.00	0.581
85.11		84.47	0.64*	
	85.11	84.47	0.64*	

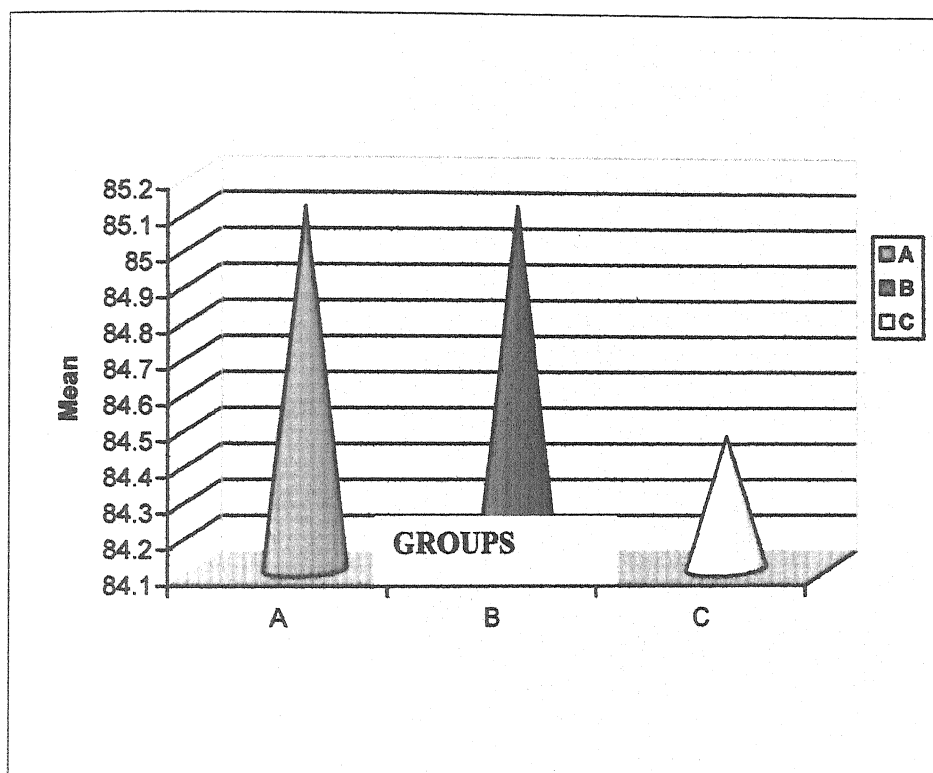
\*Significant at .05 Level.

It is evident from table - 5 that no significant difference was found between Group A and Group B.

On the other hand significant difference was found between group A and group C; group B and group C.



**Fig.-2 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN RESTING DIASTOLIC BLOOD PRESSURE**



Group A = Experimental Group (Suryabhedana)  
Group B = Experimental Group (Shitali)  
Group C = Control Group



TABLE - 6

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN RESTING  
SYSTOLIC BLOOD PRESSURE**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F-Ratio
	A	B	C					
PRE TEST MEANS	125.57	124.53	124.27	A	2	28.29	14.14	0.987
				W	87	1246.70	14.33	
POST TEST MEANS	125.70	125.70	124.27	A	2	41.09	20.54	1.069
				W	87	1672.47	19.22	
ADJUSTED POST TEST MEANS	124.89	125.97	124.81	A	2	24.99	12.49	3.408*
				W	86	315.29	3.67	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 6 that the analysis of covariance for the subjects in resting systolic blood pressure indicated that the resultant F-ratio of 0.987 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 1.069 which was higher than the pre test means but it was insignificant at .05 level of confidence, Similarly the obtained value of F-ratio 3.408 of adjusted post means was significant at the chosen level.



TABLE - 7

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN RESTING SYSTOLIC BLOOD PRESSURE**

GROUPS			Mean Difference	Critical Difference
A	B	C		
124.89	125.97		1.08*	0.161
124.89		124.81	0.08	
	125.97	124.81	1.16*	

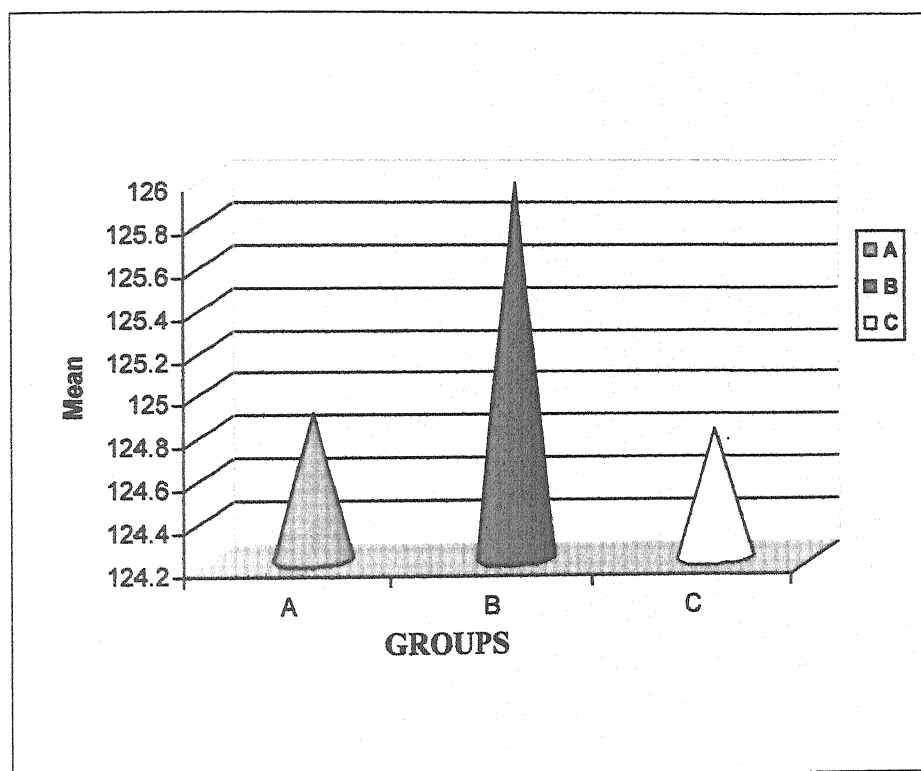
\*Significant at .05 Level.

It is evident from table - 7 that no significant difference was found between group A and group C.

On the other hand significant difference was found between group A and group B; and group B and group C.



**Fig.-3 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN RESTING SYSTOLIC BLOOD PRESSURE**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 8

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN  
VITAL CAPACITY**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F-Ratio
	A	B	C					
PRE TEST MEANS	2.823	2.537	2.677	A	2	1.233	.616	1.936
				W	87	27.697	.318	
POST TEST MEANS	3.120	2.843	2.760	A	2	2.131	1.065	3.873*
				W	87	23.934	.275	
ADJUSTED POST TEST MEANS	2.993	2.969	2.76	A	2	.965	.483	17.147*
				W	86	2.420	.028	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 8 that the analysis of covariance for the subjects in vital capacity indicated that the resultant F-ratio of 1.936 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 3.873 which was significant at .05 level of confidence; Similarly the obtained value of F-ratio 17.147 of adjusted post means was significant at the chosen level.



TABLE - 9

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN VITAL CAPACITY**

GROUPS			Mean Difference	Critical Difference
A	B	C		
2.993	2.969		.024	0.049
2.993		2.762	.231*	
	2.969	2.762	.207*	

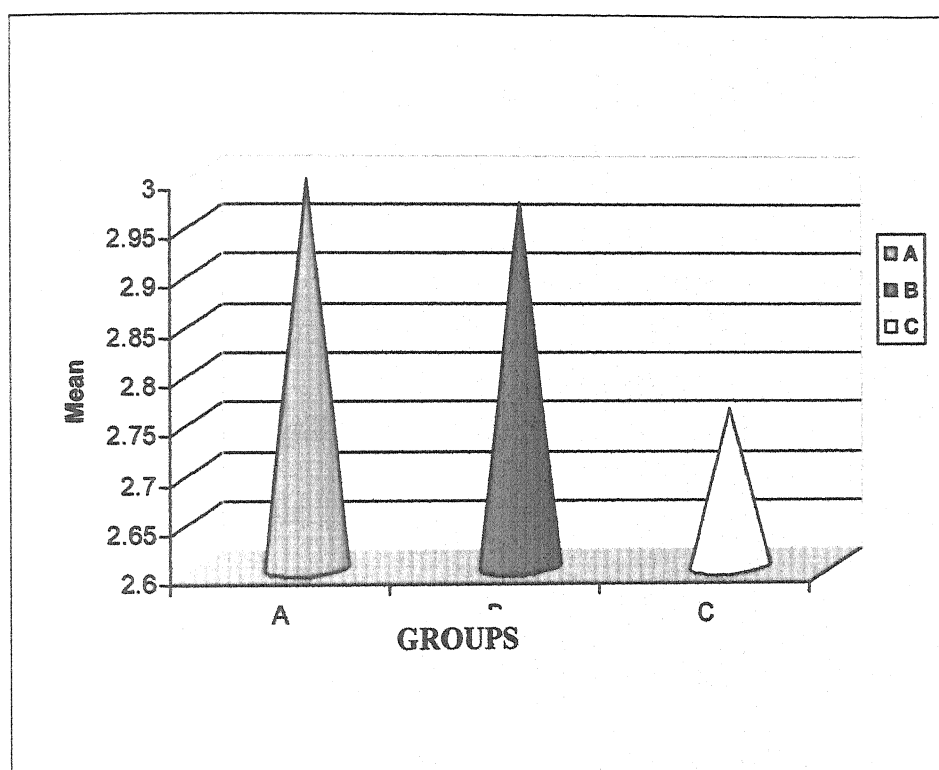
\*Significant at .05 level

It is evident from table - 9 that no significant difference was found between group A and group B.

On the other hand significant difference was found between group A and group C; group B and group C.



**Fig.- 4 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN VITAL CAPACITY**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 10

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN RESTING  
RESPIRATORY RATE**

	GROUPS			Df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	19.63	19.67	21.40	A	2	61.27	30.63	3.578*
				W	87	744.83	8.56	
POST TEST MEANS	18.60	17.43	20.17	A	2	112.87	56.43	8.065*
				W	87	608.73	6.99	
ADJUSTED POST TEST MEANS	19.11	17.91	19.18	A	2	29.63	14.82	17.55*
				W	86	72.59	.844	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 10 that the analysis of covariance for the subjects in resting respiratory rate indicated that the resultant F-ratio of 3.578 was significant in case of pre-test means which shows that pre test means differ significantly. The post test means of both group indicated a F-ratio of 8.065 which was higher than the pre test means and it was significant at .05 level of confidence; Similarly the obtained value of F-ratio 17.55 of adjusted post means was significant at the chosen level.



TABLE - 11

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN RESTING RESPIRATORY RATE**

GROUPS			Mean Difference	Critical Difference
A	B	C		
19.11	17.91		1.20*	0.037
19.11		19.18	0.07	
	17.91	19.18	1.27*	

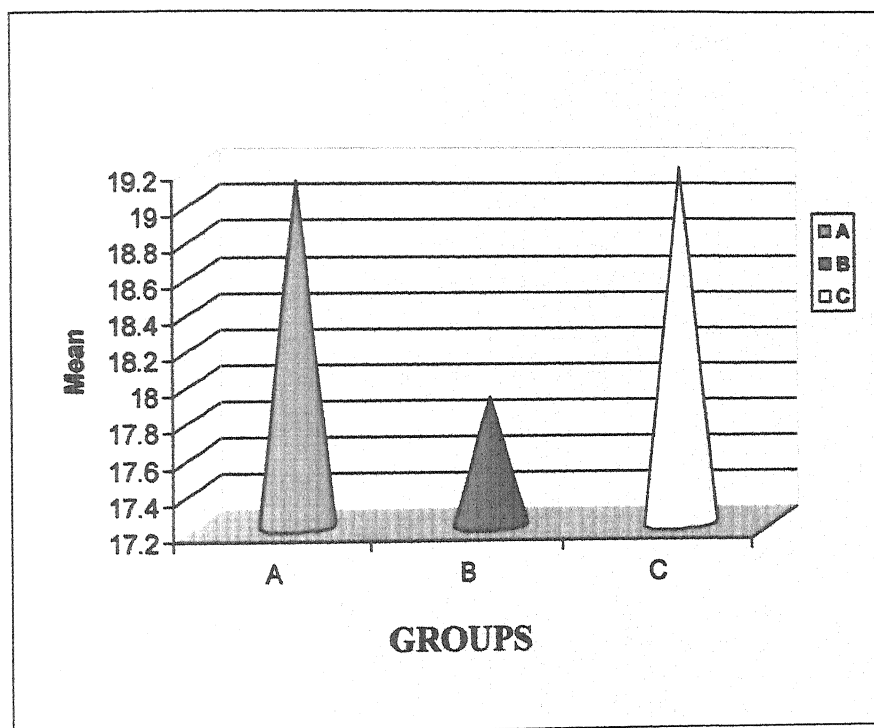
\*Significant at .05 level

It is evident from table - 11 that no significant difference was found between group A and group C.

On the other hand significant difference was found between group A and group B; group B and group C.



**Fig.- 5 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN RESTING RESPIRATORY RATE**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 12

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN MAXIMUM  
BREATH HOLDING TIME**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	51.00	54.03	53.63	A	2	162.96	81.48	0.397
				W	87	17841	205.08	
POST TEST MEANS	57.43	60.23	55.50	A	2	339.82	169.91	0.997
				W	87	14826.23	170.42	
ADJUSTED POST TEST MEANS	59.08	59.24	54.85	A	2	370.81	185.41	12.46*
				W	86	1280.26	14.89	

\*Significant at .05 level

A = Among the Groups

N = 90

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 12 that the analysis of covariance for the subjects in maximum breath holding time indicated that the resultant F-ratio of 0.397 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 0.997 which was higher than the pre test means but it was insignificant at .05 level of confidence similarly the obtained value of F-ratio 12.46 of adjusted post means was significant at the chosen level.



TABLE – 13

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN MAXIMUM BREATH HOLDING TIME**

GROUPS			Mean Difference	Critical Difference
A	B	C		
59.08	59.24		0.16	1.138
59.08		54.85	4.33*	
	59.24	54.85	4.39*	

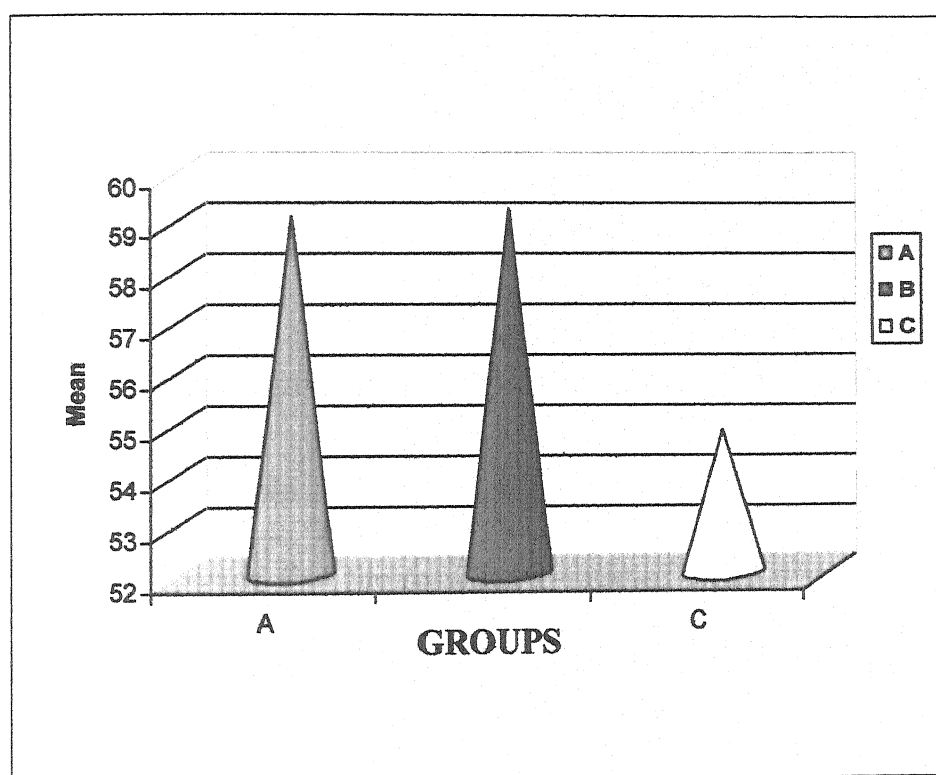
\*Significant at .05 level

It is evident from table – 3 that no significant difference was found between group A and group C.

On the other hand significant difference was found between group A and group C; group B and group C.



**Fig.- 6 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN MAXIMUM BREATH HOLDING TIME**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 14

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN AIR FLOW RATE**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	1.342	1.331	1.343	A	2	.002	.001	.773
				W	87	.132	.002	
POST TEST MEANS	1.365	1.350	1.345	A	2	.007	.003	2.27
				W	87	.127	.001	
ADJUSTED POST TEST MEANS	1.362	1.357	1.341	A	2	.007	.003	20.84*
				W	86	.014	.000	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F-ratio needed for significance at .05 level of confidence = 3.11

As shown in table 14 that the analysis of covariance for the subjects in air flow rate indicated that the resultant F-ratio of 0.773 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 2.27 which was higher than the pre test means but it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 20.84 of adjusted post means was significant at the chosen level.



TABLE - 15

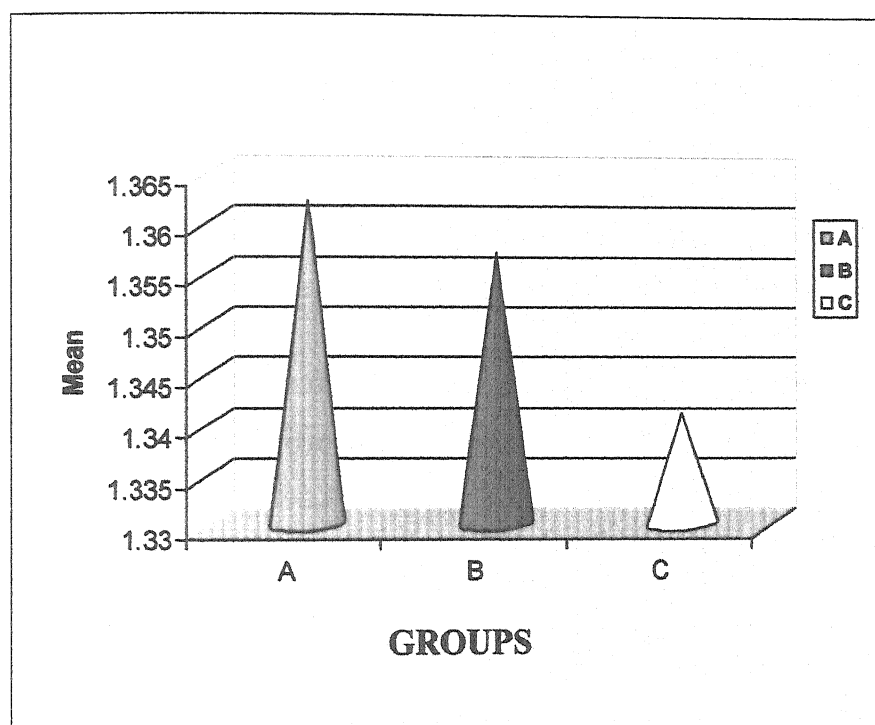
**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN AIR FLOW RATE**

GROUPS			Mean Difference	Critical Difference
A	B	C		
1.362	1.357		0.005	0.00
1.362		1.341	0.021	
	1.357	1.341	0.016	

It is evident from table - 15 that no significant difference was found between group A and group B; group A and group C; group B and group C.



**Fig.- 7 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN AIR FLOW RATE**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE -16

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN CARDIO  
VASCULAR EFFICIENCY**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	72.98	72.66	72.63	A	2	2.27	1.135	0.060
				W	87	1651.28	18.98	
POST TEST MEANS	71.11	71.49	72.65	A	2	38.08	19.039	1.169
				W	87	1417.53	16.293	
ADJUSTED POST TEST MEANS	70.93	71.58	72.75	A	2	50.76	25.38	6.514*
				W	86	335.01	3.89	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 16 that the analysis of covariance for the subjects in cardio vascular efficiency indicated that the resultant F-ratio of 0.060 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 1.169 which was higher than the pre test means but it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 6.514 of adjusted post means was significant at the chosen level.



TABLE - 17

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN CARDIO VASCULAR EFFICIENCY**

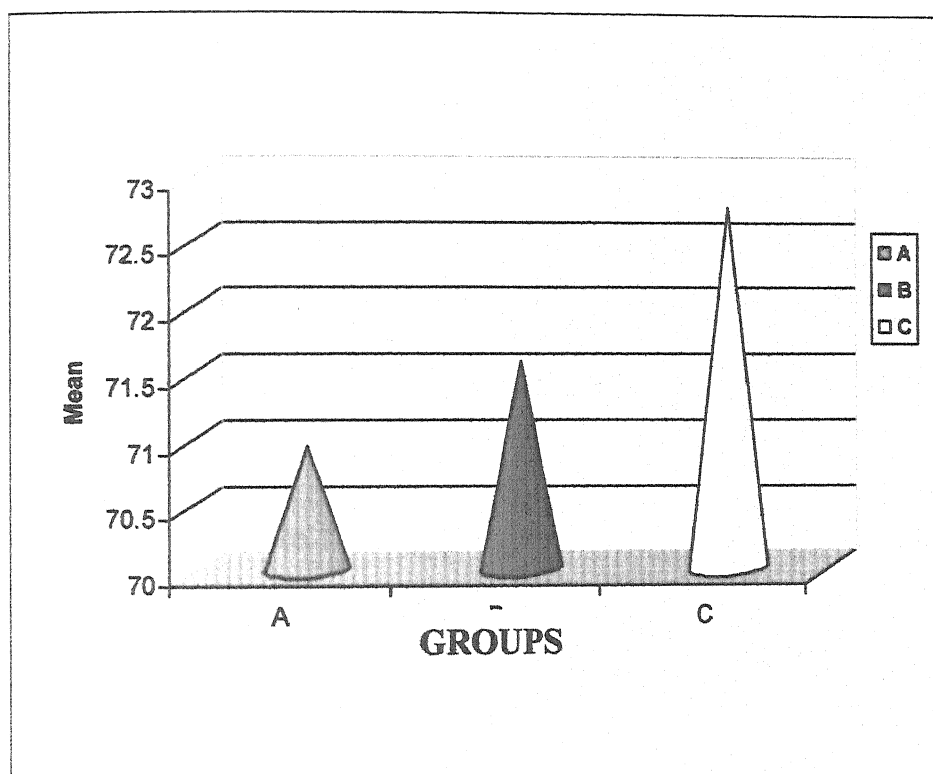
GROUPS			Mean Difference	Critical Difference
A	B	C		
70.93	71.58		0.65*	0.171
70.93		72.75	1.82*	
	71.58	72.75	2.17*	

\*Significant at .05 level

It is evident from table - 17 that significant difference was found between group A and group B; group A and group C; group B and group C.



**Fig.- 8 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN CARDIO VASCULAR EFFICIENCY**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE -18

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN  
HEMOGLOBIN CONTENTS**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	12.47	12.09	12.75	A	2	6.515	3.257	2.839
				W	87	99.82	1.147	
POST TEST MEANS	12.89	12.54	12.90	A	2	2.593	1.296	1.239
				W	87	91.031	1.046	
ADJUSTED POST TEST MEANS	12.87	12.86	12.62	A	2	1.168	.584	7.919*
				W	86	6.341	.074	

\*Significant at .05 level

A = Among the Groups

N = 90

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 18 that the analysis of covariance for the subjects in hemoglobin contents indicated that the resultant F-ratio of 2.839 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 1.239 which was lower than the pre test means and it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 7.919 of adjusted post means was significant at the chosen level.



TABLE - 19

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN HEMOGLOBIN CONTENTS**

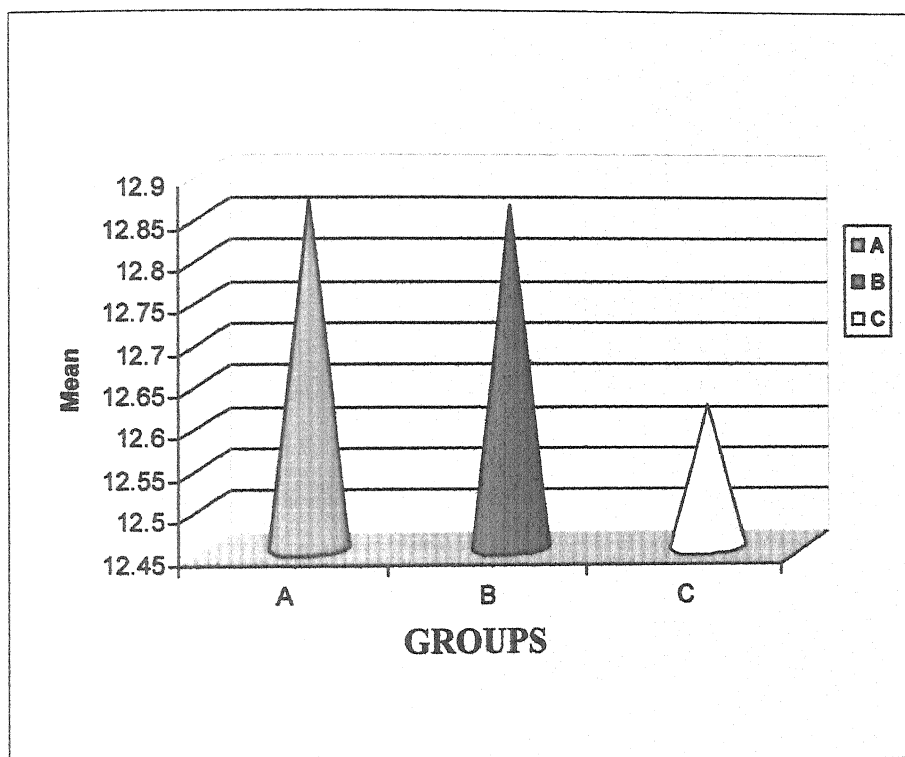
GROUPS			Mean Difference	Critical Difference
A	B	C		
12.87	12.86		0.01*	0.003
12.87		12.62	0.25*	
	12.86	12.62	0.24*	

\*Significant at .05 level

It is evident from table - 19 that significant difference was found between group A and group B; group A and group C; group B and group C.



**Fig.- 9 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN HEMOGLOBIN CONTENTS**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 20

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN STATE ANXIETY**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F-Ratio
	A	B	C					
PRE TEST MEANS	56.33	56.57	56.63	A	2	1.489	.744	0.071
				W	87	909.00	10.448	
POST TEST MEANS	56.57	59.43	57.53	A	2	127.62	63.81	1.370
				W	87	4052.20	46.58	
ADJUSTED POST TEST MEANS	56.75	59.38	57.41	A	2	112.06	56.03	1.557
				W	86	3094.91	35.99	

\*Significant at .05 level

N = 90

A = Among the Groups

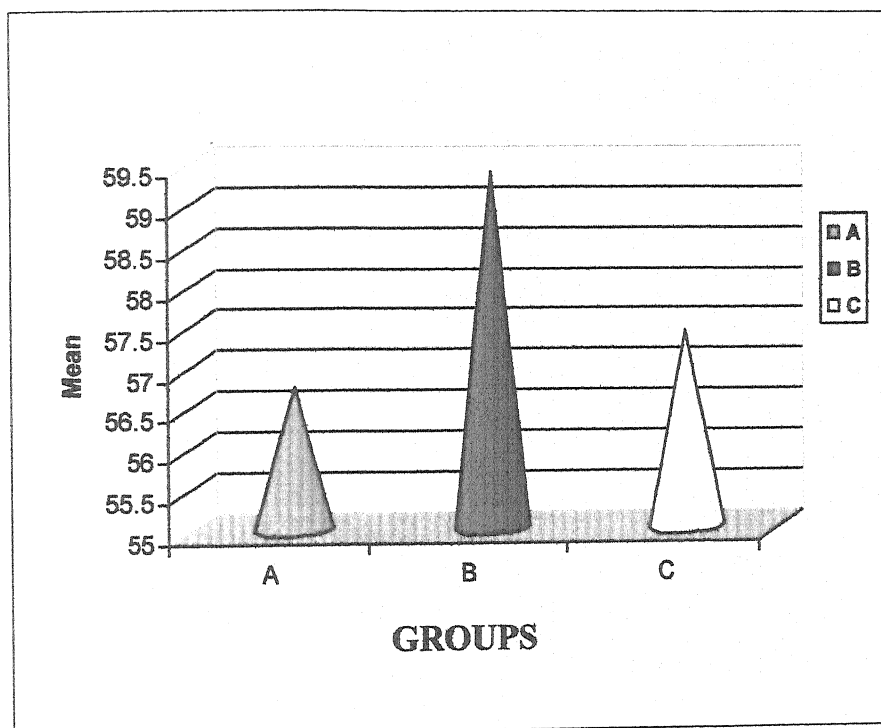
W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 20 that the analysis of covariance for the subjects in state anxiety indicated that the resultant F-ratio of 0.071 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 1.370 which was higher than the pre test means but it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 1.557 of adjusted post means was not significant at the chosen level.



**Fig.- 10 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN STATE ANXIETY**



Group A = Experimental Group (Suryabhedana)  
Group B = Experimental Group (Shitali)  
Group C = Control Group



TABLE - 21

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN  
COGNITIVE ANXIETY**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	37.80	46.33	36.93	A	2	1619.29	809.64	5.672*
				W	87	12419.33	142.75	
POST TEST MEANS	38.60	48.43	34.97	A	2	2912.47	1456.23	8.972*
				W	87	14121.53	162.31	
ADJUSTED POST TEST MEANS	40.62	43.71	37.67	A	2	493.77	246.88	3.342*
				W	86	6353.35	73.88	

\*Significant at .05 level

A = Among the Groups

N = 90

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 21 that the analysis of covariance for the subjects in cognitive anxiety indicated that the resultant F-ratio of 5.672 was significant in case of pre-test means which shows that pre test means differ significantly. The post test means of both group indicated a F-ratio of 8.972 which was higher than the pre test means and it was significant at .05 level of confidence; Similarly the obtained values of F-ratio 3.342 of adjusted post means was significant at the chosen level.



TABLE -22

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN COGNITIVE ANXIETY**

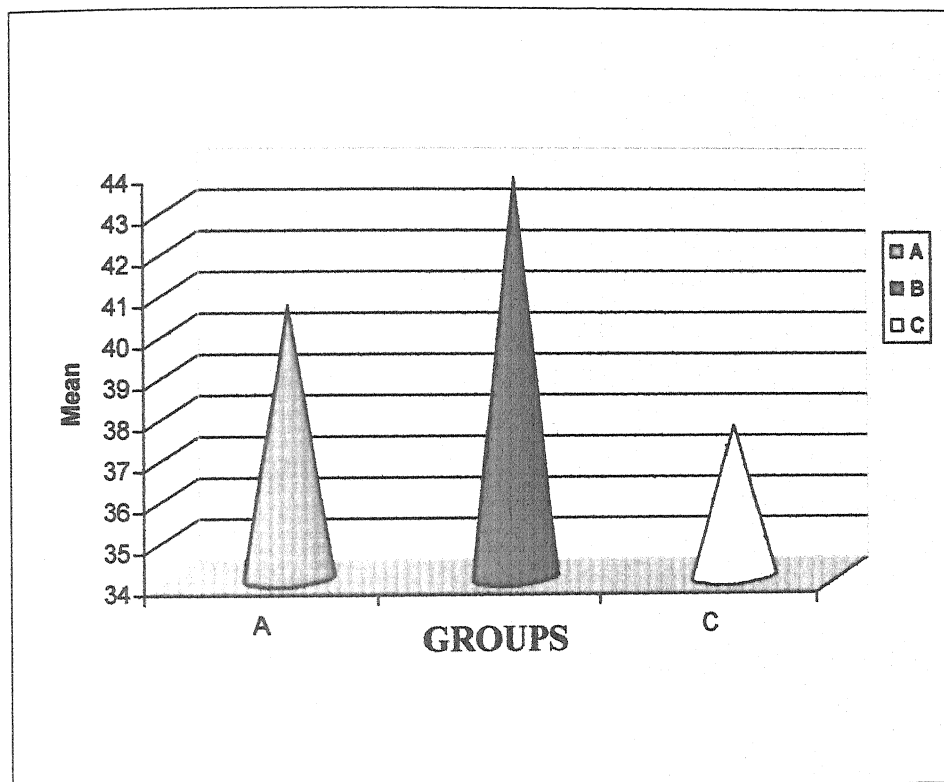
GROUPS			Mean Difference	Critical Difference
A	B	C		
40.62	43.71		3.09*	2.53
40.62		37.67	2.95*	
	43.71	37.67	6.04*	

\*Significant at .05 level

It is evident from table - 22 that significant difference was found between group A and group B; group A and group C; group B and group C.



**Fig.- 11 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN COGNITIVE ANXIETY**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE -23

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN SPORTS  
SELF CONFIDENCE**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	162.70	165.16	157.80	A	2	843.62	421.81	2.928
				W	87	12531.27	144.04	
POST TEST MEANS	169.40	164.83	162.73	A	2	697.09	348.54	1.710
				W	87	17731.23	203.81	
ADJUSTE D POST TEST MEANS	169.30	164.45	163.22	A	2	616.39	308.19	1.510
				W	86	17556.71	204.19	

\*Significant at .05 level

N = 90

A = Among the Groups

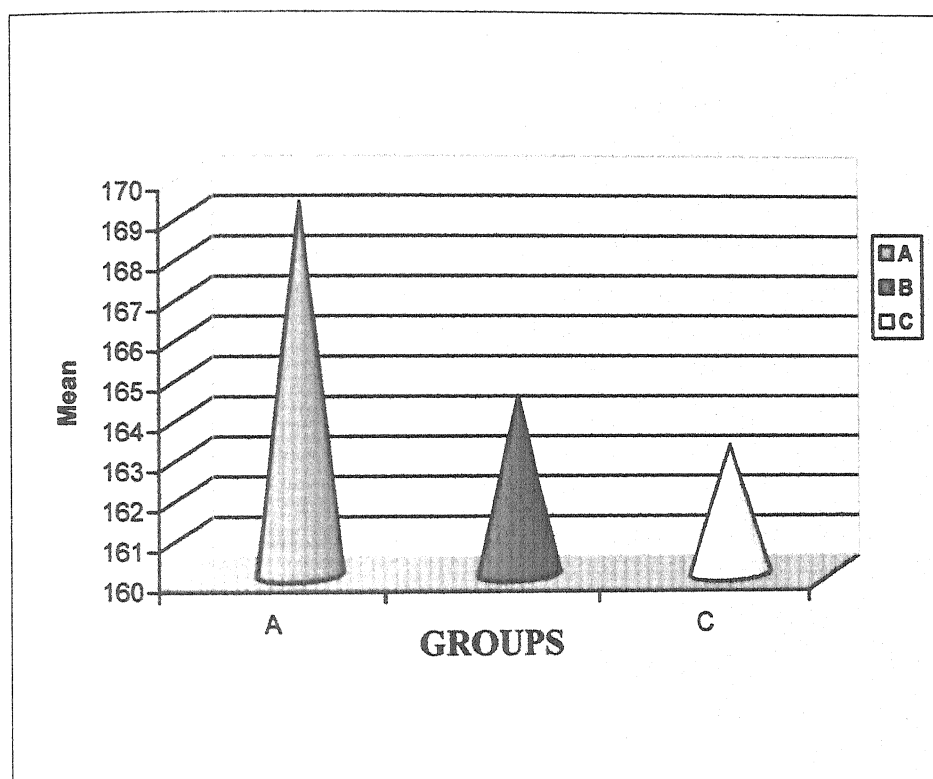
W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 23 that the analysis of covariance for the subjects in sports self confidence indicated that the resultant F-ratio of 2.928 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 1.710 which was lower than the pre test means but it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 1.510 of adjusted post means was not significant at the chosen level.



**Fig.- 12 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN SPORTS SELF CONFIDENCE**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 24

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP IN  
LOCUS OF CONTROL**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	53.93	55.70	55.73	A	2	63.62	31.81	0.844
				W	87	3278.03	37.68	
POST TEST MEANS	55.33	54.97	53.73	A	2	42.16	21.078	2.099
				W	87	873.50	10.040	
ADJUSTED POST TEST MEANS	55.41	54.93	53.69	A	2	46.95	23.476	2.354
				W	86	857.61	9.972	

\*Significant at .05 level

N = 90

A = Among the Groups

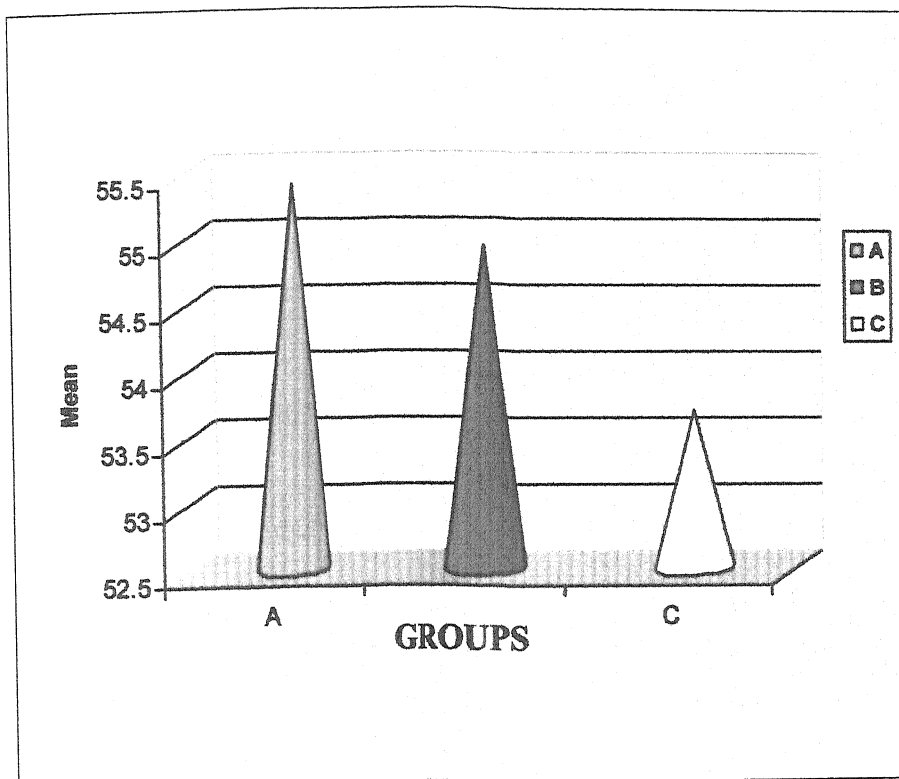
W = Within the Groups

F-ratio needed for significance at .05 level of confidence = 3.11

As shown in table 24 that the analysis of covariance for the subjects in locus of control indicated that the resultant F-ratio of 0.844 was not significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 2.099 which was higher than the pre test means but it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 2.354 of adjusted post means was insignificant at the chosen level.



**Fig.- 13 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN LOCUS OF CONTROL**



Group A = Experimental Group (Suryabhedana)

Group B = Experimental Group (Shitali)

Group C = Control Group



TABLE - 25

**ANALYSIS OF COVARIANCE OF TWO EXPERIMENTAL  
GROUPS AND CONTROL GROUP  
IN CONCENTRATION**

	GROUPS			df		Sum of Squares	Means Sum of Squares	F- Ratio
	A	B	C					
PRE TEST MEANS	94.70	93.20	88.27	A	2	679.76	339.88	3.22*
				W	87	9182.97	105.55	
POST TEST MEANS	88.53	87.67	87.00	A	2	35.467	17.74	0.189
				W	87	8152.13	93.70	
ADJUSTED POST TEST MEANS	86.17	86.65	90.38	A	2	296.63	148.31	15.01*
				W	86	849.87	9.88	

\*Significant at .05 level

N = 90

A = Among the Groups

W = Within the Groups

F- ratio needed for significance at .05 level of confidence = 3.11

As shown in table 25 that the analysis of covariance for the subjects in concentration indicated that the resultant F-ratio of 3.22 was significant in case of pre-test means which shows that pre test means did not differ significantly because of random group design. The post test means of both group indicated a F-ratio of 0.189 which was lower than the pre test means but it was insignificant at .05 level of confidence; Similarly the obtained values of F-ratio 15.01 of adjusted post means was significant at the chosen level.



TABLE - 26

**COMPARISON OF ADJUSTED POST TEST MEANS OF TWO  
EXPERIMENTAL GROUPS AND CONTROL GROUP  
IN CONCENTRATION**

GROUPS			Mean	Critical
A	B	C	Difference	Difference
86.17	86.65		0.48	0.927
86.17		90.38	4.21*	
	86.65	90.38	3.73*	

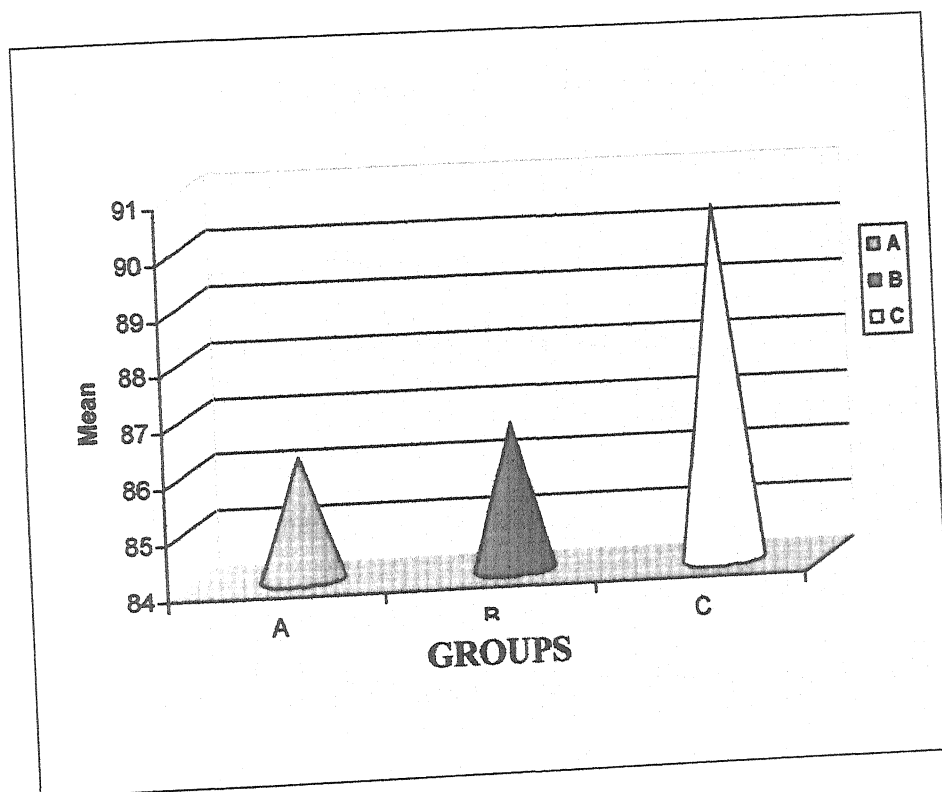
\*Significant at .05 level

It is evident from table - 26 that no significant difference was found between group A and group C.

On the other hand significant difference was found between group A and group B; group B and group C.



**Fig.- 14 : COMPARISON OF ADJUSTED POST TEST MEANS OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN CONCENTRATION**



Group A = Experimental Group (Suryabhedana)  
Group B = Experimental Group (Shitali)  
Group C = Control Group



### Discussion of Findings

Both the groups i.e. Suryabhedana group and Shitali group proved to be equal in improving resting pulse rate, resting diastolic blood pressure, vital capacity, maximum breath holding time, cardio vascular efficiency and hemoglobin contents. It may be attributed to the fact that the practice of Suryabhedana and Shitali pranayama which may cause decrease in resting pulse rate, and slight increase in resting diastolic blood pressure, increase in vital capacity, maximum breath holding time, cardiovascular efficiency and hemoglobin contents while performing suryabhedana pranayama the breathing is to be taken through right nostril and inhale until the pressure is felt on the body upto the nail. Similarly pressure is developed during shitali pranayama where breathing is taken through mouth. Then the air is exhale through left nostril in case of suryabhedana and through both nostril in case of shitali pranayama. This process is repeated several time and probably the reason repeated doing for such practice brought significant changes in the said physiological variables. Whereas shitali group proved to be better in case of resting systolic blood pressure and resting respiratory rate.



Bhole and Karambelkar<sup>1</sup> studied the effect of yoga training on vital capacity and observed that vital capacity was improved significantly. This study also support the same study.

From the findings it was also observed that practice of Shitali pranayama proved to be better in case of resting systolic blood pressure and resting respiratory rate. It may be attributed to the fact that during the practice of shitali pranayama air is inhale through mouth and volume of oxygen is increased in the body for a longer duration probably that might be the reason which brings the significant changes.

Both the groups i.e. Suryabhedana group and Shitali group proved to be equal in improving resting respiratory rate, this might be due to the reason that both the pranayama practices involves respiratory movement to a great extent.

Suryabhedana group and Shitali group did not improve Breath holding time and cardio vascular efficiency but in case of adjusted means F -ratio was found to be significant at .05 level. It may be attributed to the fact that

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<sup>1</sup> M.V. Bhole and P.V. Karambelkar, " Effect of Yoga Training on Vital Capacity and Breath Holding Time" Yoga Mimansa XIV, Oct. 1971 & Jan. 1972.



in both kind of pranayama practice pressure of oxygen is created over the lungs which may have brought significant changes in the result.

From the findings it was observed that F-ratio was not found to be significant at .05 level in case of state anxiety, sports self confidence and locus of control. The probably the reason may be that the duration of training load, quantum of load and duration of practice was not sufficient for bringing sufficient changes.

However from the findings it was observed that in case of cognitive anxiety and concentration F-ratio was found to be significant at .05 level. It may be attributed to the fact that practice of suryabhedana and shitali pranayama is done several times and relatively for the longer duration which might have brought significant changes.



## Chapter – V

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### Summary

The purpose of this study was to determine the effect of Pranayama on selected physiological and psychological variables. The subjects were ninety (90) male student of Khalsa School, Bulandshahr. The subjects were ranging from 10 to 15 years of age. Subjects were randomly divided into three groups i.e. two experimental group (A & B) and control group (C). Experimental groups participated in a training programme of Pranayama i.e. Group A was exposed to Suryabhedana Pranayama, group B was exposed to Shitali pranayama for a period of eight weeks and control group was not exposed to any kind of training programme. The training of each pranayama was given every day early in the morning (thrice a week i.e. Monday, Wednesday and Friday- Suryabhedana pranayama and Tuesday, Thursday and Saturday- Shitali pranayama). Selected Physiological variables were: resting pulse rate, resting diastolic blood pressure, resting systolic blood pressure, vital capacity, resting respiratory rate, maximum breath holding time, air flow rate, cardio-vascular efficiency and hemoglobin contents.



Selected psychological variables were: state anxiety, cognitive anxiety, sports self confidence, locus of control and concentration. Pre and post test data on selected physiological and psychological variables were recorded prior and after completion of eight week pranayama training of experimental groups and control group respectively.

The data on physiological variables were recorded with the help of standard procedure such as: resting pulse rate by Cotel Keating Pulse Monitor, resting blood pressure (diastolic and systolic) by sphygmomanometer and stethoscope, vital capacity by Wet Spirometer, resting respiratory rate by counting the respiratory movement, maximum breath holding time by after forced inhalation air flow rate by air flow meter cardio-vascular efficiency by Harvard Step Test, hemoglobin contents by hemometer. The data on selected psychological variables were collected by using the questionnaire/test such as: state anxiety by SCAT questionnaire, cognitive anxiety by CSCAT questionnaire, sports self confidence by sports self confidence questionnaire, locus of control by locus of control questionnaire and concentration by mirror drawing concentration test. In order to study the effect of pranayama on selected physiological and psychological variables. The analysis of covariance statistical technique was



employed to analyse the raw data at .05 level of significance. From the finding it was observed that F-ratio was found to be significant at .05 level in case of physiological variables such as: resting pulse rate, resting blood pressure (diastolic and systolic), vital capacity, resting respiratory rate maximum breath holding time, air flow rate, cardio vascular efficiency and hemoglobin contents whereas in case of psychological variables F-ratio was found to be significant in cognitive anxiety and concentration. However in case of state anxiety, sports self confidence and locus of control F-ratio was not found to be significant.

### Conclusions

Within the limitations of the study the following conclusions may be drawn:-

1. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving resting pulse rate.
2. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving resting diastolic blood pressure.
3. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving vital capacity.



4. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving maximum breath holding time.
5. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving cardio vascular efficiency.
6. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving hemoglobin contents.
7. Shitali group proved to be superior then suryabhedana group in the improvement of resting systolic blood pressure.
8. Shitali group proved to be superior then suryabhedana group in the improvement of resting respiratory rate.
9. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving cognitive anxiety.
10. Both the groups i.e. suryabhedana group and shitali group proved to be equal in improving concentration.
11. Both the groups i.e. suryabhedana group and shitali group did not improve the state anxiety.



12.Both the groups i.e. suryabhedana group and shitali group did not improve the sports self confidence.

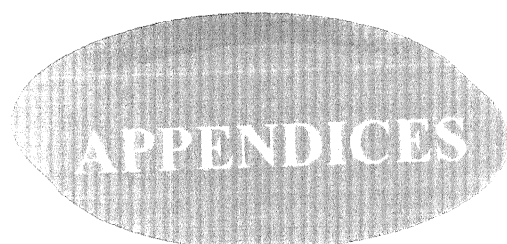
13.Both the groups i.e. suryabhedana group and shitali group did not improve the locus of control.

### Recommendations

In light of the conclusion drawn, the following recommendations are made:-

- 1- The similar study may be conducted by using other pranayama.
- 2- The similar study may be carried out by using the larger sample size.
- 3- The similar study may be conducted on the female subjects.
- 4- The variables which are used in this study may also be included in further research projects.





## APPENDICES



## APPENDIX - A

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
RESTING PULSE RATE**

(Numbers /Minute)

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	72	68	72	66	76	75
2	74	67	76	68	76	74
3	66	64	74	65	92	86
4	80	77	76	69	84	80
5	84	76	64	61	68	80
6	60	60	76	66	72	70
7	76	69	80	72	76	71
8	72	67	72	67	76	73
9	70	66	68	63	72	70
10	82	78	80	71	72	68
11	73	69	74	68	75	74
12	75	68	78	70	75	73
13	67	65	76	67	91	85
14	81	78	78	71	83	79
15	85	77	66	63	67	79
16	61	61	78	68	71	69
17	77	70	82	74	75	70
18	73	68	74	69	75	72
19	71	67	70	65	71	69
20	83	79	82	73	71	67
21	71	67	71	65	77	76
22	73	66	75	67	77	75
23	65	63	73	64	93	87
24	79	76	75	68	84	81
25	83	75	63	60	69	81
26	69	69	75	65	73	71
27	75	68	79	71	77	72
28	71	66	71	66	77	74
29	69	65	67	62	73	71
30	81	77	79	70	73	69



## APPENDIX - B

**RAW SCORES OF TWO EXPERIMENTAL GROUPS AND  
CONTROL GROUP IN RELATION TO RESTING  
DIASTOLIC BLOOD PRESSURE**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	85	86	81	82	82	82
2	80	81	85	84	83	81
3	86	83	91	90	92	93
4	90	92	86	87	84	82
5	85	82	82	80	86	87
6	82	85	91	92	81	82
7	86	83	87	86	84	81
8	85	86	86	87	82	84
9	90	88	82	80	86	85
10	85	87	92	92	81	80
11	86	83	86	85	82	83
12	86	87	83	85	80	80
13	81	82	87	86	81	79
14	87	84	93	89	90	91
15	91	93	88	89	82	80
16	86	83	84	82	82	85
17	83	86	93	93	79	80
18	81	84	89	88	82	79
19	86	87	87	84	80	82
20	91	89	88	86	84	83
21	86	88	84	87	79	78
22	87	84	80	83	80	81
23	84	85	94	91	81	81
24	79	80	81	83	82	80
25	85	82	85	87	91	92
26	89	91	81	83	83	81
27	84	81	90	87	85	86
28	81	84	90	93	80	81
29	79	82	91	94	80	84
30	84	86	90	88	85	84



## APPENDIX - C

**RAW SCORES OF TWO EXPERIMENTAL GROUPS AND  
CONTROL GROUP IN RELATION TO RESTING  
SYSTOLIC BLOOD PRESSURE**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	122	122	124	124	123	123
2	124	123	126	136	124	126
3	130	131	120	120	121	120
4	127	128	131	132	131	132
5	119	118	126	126	121	120
6	126	126	121	124	130	130
7	132	132	125	126	121	120
8	128	126	122	124	126	126
9	122	124	124	125	124	124
10	126	126	123	120	121	122
11	123	123	125	125	124	124
12	125	124	127	137	127	127
13	131	132	121	121	122	121
14	128	129	132	133	132	133
15	120	119	127	127	122	121
16	127	127	122	125	131	131
17	133	133	126	127	122	121
18	128	127	123	125	127	127
19	122	125	125	126	125	125
20	127	127	124	121	122	122
21	121	121	123	123	122	122
22	123	122	125	135	123	125
23	129	130	119	119	120	119
24	126	127	130	131	130	131
25	118	117	125	125	120	119
26	125	125	120	123	129	129
27	131	131	124	125	120	119
28	127	125	121	123	125	125
29	121	123	123	124	123	123
30	125	125	122	119	120	121



## APPENDIX - D

RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
VITAL CAPACITY

(Litres)

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	2.9	3.1	1.8	2.3	2.7	2.9
2	2.8	3.2	2.1	2.6	2.4	2.5
3	3.1	3.4	3.0	3.3	2.3	2.5
4	2.6	2.9	3.0	3.1	2.5	2.6
5	2.1	2.4	2.2	2.7	3.4	3.4
6	3.4	3.7	3.3	3.3	3.0	3.1
7	2.9	3.1	2.2	2.4	3.2	3.1
8	3.2	3.3	2.2	2.6	2.7	2.8
9	2.5	2.9	2.0	2.5	2.7	2.9
10	2.6	2.8	3.0	3.1	2.8	2.8
11	3.0	3.2	1.9	2.4	1.7	1.9
12	2.7	3.1	2.0	2.5	3.4	3.5
13	3.3	3.7	3.2	3.5	1.3	1.5
14	2.4	2.5	3.1	3.2	3.5	3.6
15	2.0	2.3	2.0	2.5	4.4	4.4
16	3.5	3.8	3.1	3.1	3.0	3.1
17	3.0	3.2	2.4	2.6	2.2	2.1
18	3.0	3.1	2.3	2.7	1.7	1.8
19	2.7	3.1	2.1	2.6	3.7	3.9
20	2.5	2.7	3.2	3.3	1.8	1.8
21	2.8	3.0	1.7	2.2	2.7	2.9
22	2.9	3.3	2.2	2.7	2.4	2.5
23	3.0	3.3	3.1	3.4	2.3	2.5
24	2.5	2.8	3.2	3.3	2.5	2.6
25	2.2	2.5	2.1	2.3	4.4	4.4
26	3.3	3.6	2.0	2.4	4.0	4.1
27	3.2	3.3	3.3	3.4	2.2	2.1
28	3.3	3.4	2.5	2.9	1.7	1.8
29	2.4	2.8	3.4	3.5	3.7	3.9
30	2.9	3.1	2.5	2.9	1.8	1.8



## APPENDIX - E

# RAW SCORES OF TWO EXPERIMENTAL GROUPS AND CONTROL GROUP IN RELATION TO RESTING RESPIRATORY RATE

(Numbers /Minute)

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	17	17	18	16	18	18
2	19	19	20	17	21	20
3	21	20	20	19	25	22
4	23	20	22	18	21	19
5	18	18	18	15	15	15
6	16	17	16	15	20	18
7	21	19	20	17	24	23
8	23	18	24	21	25	25
9	20	20	21	19	20	19
10	19	18	18	17	26	25
11	18	18	17	15	13	13
12	20	19	19	16	22	21
13	20	19	21	20	24	21
14	22	18	23	14	21	19
15	18	17	18	15	14	14
16	18	18	15	14	19	17
17	20	19	21	18	16	15
18	23	22	23	20	24	24
19	21	19	20	18	21	20
20	18	19	19	18	27	26
21	17	16	18	16	18	16
22	21	18	20	17	23	22
23	19	19	19	18	27	24
24	20	18	21	17	20	18
25	19	19	20	17	18	13
26	18	19	14	13	22	20
27	20	17	22	19	26	25
28	19	19	19	17	24	24
29	21	20	20	19	22	21
30	20	19	19	17	26	24



**APPENDIX – F**  
**RAW SCORES OF TWO EXPERIMENTAL GROUPS**  
**AND CONTROL GROUP IN RELATION TO**  
**MAXIMUM BREATH HOLDING TIME**

(Seconds)

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	48	56	60	66	35	38
2	35	47	40	52	26	30
3	31	60	60	67	29	31
4	30	54	37	48	50	48
5	39	56	39	42	82	80
6	40	52	74	78	55	56
7	48	58	52	59	75	73
8	61	67	75	75	60	64
9	70	75	50	61	71	72
10	48	56	45	48	60	63
11	49	57	59	65	34	37
12	36	48	49	51	25	29
13	52	61	59	66	28	30
14	51	55	36	47	49	47
15	40	57	38	41	81	79
16	41	53	73	77	54	55
17	49	59	51	58	74	72
18	62	68	51	58	59	63
19	71	76	74	74	70	71
20	49	57	49	60	59	62
21	47	55	44	47	36	39
22	44	46	61	67	27	31
23	50	59	41	53	30	32
24	49	43	61	68	51	49
25	48	55	38	49	83	81
26	39	51	40	43	56	57
27	47	57	75	79	76	74
28	60	66	53	60	61	65
29	69	74	76	76	72	73
30	47	55	51	62	61	64



## APPENDIX - G

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
AIR-FLOW RATE**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	1.28	1.29	1.29	1.32	1.31	1.31
2	1.36	1.40	1.31	1.35	1.36	1.37
3	1.37	1.41	1.28	1.34	1.32	1.31
4	1.39	1.40	1.30	1.34	1.37	1.37
5	1.38	1.41	1.38	1.41	1.35	1.35
6	1.26	1.27	1.36	1.38	1.32	1.32
7	1.33	1.35	1.38	1.38	1.33	1.33
8	1.36	1.35	1.33	1.35	1.39	1.40
9	1.35	1.40	1.30	1.34	1.38	1.38
10	1.38	1.39	1.29	1.32	1.39	1.39
11	1.33	1.34	1.33	1.34	1.32	1.32
12	1.30	1.34	1.39	1.41	1.33	1.33
13	1.39	1.41	1.30	1.32	1.31	1.32
14	1.38	1.42	1.29	1.30	1.33	1.33
15	1.31	1.33	1.30	1.30	1.35	1.35
16	1.39	1.42	1.32	1.32	1.38	1.39
17	1.36	1.38	1.39	1.40	1.29	1.29
18	1.26	1.31	1.41	1.42	1.32	1.32
19	1.31	1.34	1.30	1.31	1.30	1.30
20	1.42	1.43	1.32	1.33	1.36	1.37
21	1.28	1.31	1.36	1.38	1.38	1.38
22	1.29	1.33	1.33	1.35	1.39	1.40
23	1.36	1.35	1.28	1.30	1.31	1.31
24	1.35	1.34	1.27	1.31	1.33	1.33
25	1.32	1.35	1.40	1.41	1.38	1.38
26	1.39	1.42	1.39	1.39	1.37	1.37
27	1.36	1.40	1.36	1.37	1.35	1.35
28	1.39	1.41	1.35	1.36	1.32	1.32
29	1.33	1.33	1.34	1.35	1.33	1.33
30	1.29	1.32	1.30	1.31	1.31	1.32



## APPENDIX - H

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
CARDIO VASCULAR EFFICIENCY**

(P.F.I.)

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	79.03	78.82	74.29	73.87	68.04	68.05
2	64.30	63.94	68.89	67.68	71.39	71.38
3	68.29	67.87	74.37	72.94	74.59	74.60
4	79.23	78.12	68.59	67.39	79.05	79.12
5	73.46	72.23	69.23	68.12	68.94	68.96
6	65.45	65.21	80.12	79.04	71.58	71.61
7	68.23	67.39	78.03	77.43	68.93	68.82
8	81.08	80.02	78.45	77.23	71.54	71.62
9	78.43	77.21	74.55	72.84	70.92	70.94
10	74.39	72.12	76.39	75.23	68.39	68.40
11	70.28	69.38	79.48	78.24	70.54	70.56
12	69.25	68.12	69.43	78.45	71.39	71.42
13	66.53	65.32	73.25	72.84	76.54	76.55
14	68.23	66.94	69.28	68.12	77.39	77.42
15	77.54	76.38	68.28	66.89	69.54	69.55
16	74.39	73.28	69.38	68.21	72.39	72.42
17	72.59	70.98	69.94	68.25	76.58	76.62
18	70.25	68.87	71.04	70.58	78.38	78.42
19	80.12	78.08	73.43	72.28	74.54	74.54
20	79.54	78.38	74.05	73.02	78.28	78.31
21	78.68	77.54	76.59	75.82	74.34	74.35
22	74.39	72.26	72.28	71.31	71.59	71.61
23	72.94	71.68	70.78	68.84	78.35	78.35
24	71.04	70.28	72.38	71.24	76.24	76.25
25	65.94	64.38	71.54	70.22	72.59	72.61
26	68.48	67.59	70.29	69.13	71.38	71.38
27	70.28	68.39	69.43	68.24	70.58	70.59
28	66.39	67.28	70.45	68.84	68.39	68.40
29	70.52	68.54	71.20	70.12	67.94	67.95
30	68.28	66.84	74.39	72.58	68.58	68.58



## APPENDIX - I

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
HEMOGLOBIN PERCENTAGE**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	13.00	13.20	12.00	12.60	12.00	12.20
2	12.80	13.00	12.00	12.50	12.50	12.50
3	12.50	13.30	13.00	13.50	13.00	13.00
4	12.50	13.00	11.50	12.20	12.50	12.80
5	11.50	12.60	12.00	13.10	13.00	13.00
6	13.10	13.50	13.00	13.40	12.50	12.50
7	12.50	12.90	11.50	12.00	13.00	13.20
8	12.30	12.80	12.40	13.00	12.00	12.50
9	13.00	13.40	12.00	12.50	12.70	13.00
10	12.00	12.50	12.60	13.00	13.00	13.00
11	14.00	14.20	12.00	12.60	11.00	11.20
12	11.80	12.00	11.00	11.50	12.50	12.50
13	11.50	12.30	12.00	12.50	12.00	12.00
14	11.50	12.00	10.50	11.20	13.50	13.80
15	14.10	14.50	11.00	12.10	14.00	14.00
16	13.50	13.90	14.00	14.40	13.50	13.50
17	11.30	11.80	11.50	12.00	14.00	14.20
18	11.00	11.40	11.40	11.00	11.00	11.50
19	12.00	12.50	13.00	13.50	13.70	14.00
20	15.00	15.20	13.60	14.00	12.00	12.00
21	12.80	13.00	11.00	11.60	13.00	13.20
22	10.50	11.30	13.00	12.50	13.50	13.50
23	13.50	14.00	11.00	11.60	12.00	12.00
24	15.10	15.50	10.50	11.20	14.50	14.80
25	12.50	12.90	12.00	13.10	11.00	11.00
26	12.30	12.80	15.00	15.40	14.50	14.50
27	12.00	12.40	10.50	11.00	11.00	11.20
28	11.00	11.50	12.40	12.00	14.00	14.50
29	11.50	11.60	13.00	12.80	13.70	14.00
30	12.10	12.20	12.50	12.60	12.00	12.00



## APPENDIX - J

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
STATE ANXIETY**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	59	62	58	60	57	59
2	52	58	53	59	58	59
3	57	56	60	59	52	55
4	59	62	58	63	58	50
5	52	52	56	56	57	56
6	57	57	62	61	55	54
7	52	48	53	56	62	66
8	59	58	56	64	52	49
9	62	66	54	59	57	58
10	53	55	56	53	55	63
11	60	63	57	69	59	61
12	53	59	52	58	60	62
13	58	57	59	58	54	57
14	60	63	57	61	60	52
15	53	53	55	55	59	58
16	58	58	61	60	57	56
17	53	49	53	55	64	68
18	60	59	55	63	54	51
19	63	67	53	58	59	57
20	54	56	55	52	57	65
21	57	60	59	61	56	58
22	50	56	54	60	57	58
23	56	55	61	60	51	54
24	58	61	59	64	57	49
25	51	47	57	57	56	55
26	58	57	63	62	54	53
27	61	65	54	57	61	65
28	52	54	57	65	51	48
29	55	57	54	59	56	54
30	58	61	56	53	54	62



## APPENDIX - K

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
COGNITIVE ANXIETY**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	43	47	44	48	45	52
2	36	28	43	36	39	33
3	19	21	76	47	35	31
4	44	46	35	44	34	30
5	33	50	38	30	20	16
6	38	44	57	52	30	26
7	29	21	90	06	43	41
8	47	54	31	47	49	49
9	46	41	37	46	33	30
10	43	34	43	45	35	43
11	44	48	43	47	54	51
12	35	27	44	37	40	34
13	20	22	47	45	34	30
14	45	47	34	43	33	29
15	32	49	39	31	21	17
16	39	45	36	51	29	25
17	30	22	85	95	44	42
18	46	53	30	46	50	50
19	45	40	38	47	32	29
20	44	35	44	46	36	44
21	43	47	44	48	56	53
22	36	28	45	38	40	34
23	18	20	76	47	34	30
24	43	45	35	43	35	31
25	34	51	38	30	14	15
26	37	43	55	50	29	25
27	30	22	94	98	42	40
28	48	55	29	45	48	48
29	45	40	39	48	32	29
30	42	33	45	47	34	42



## APPENDIX - L

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
SPORTS SELF CONFIDENCE**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	165	151	146	162	160	161
2	179	177	180	165	156	165
3	157	174	149	156	152	154
4	143	159	142	162	157	180
5	153	196	169	166	164	172
6	189	166	164	166	161	169
7	175	198	172	191	144	150
8	158	166	185	132	159	161
9	153	148	186	179	160	144
10	165	160	167	172	165	170
11	166	152	144	160	161	162
12	178	176	181	166	155	164
13	158	175	148	155	151	153
14	141	157	140	160	158	181
15	154	197	170	167	163	171
16	188	167	163	165	162	170
17	177	200	177	192	143	149
18	156	164	183	129	160	162
19	154	149	155	178	159	143
20	166	161	168	173	166	171
21	164	150	145	161	159	160
22	180	178	179	164	157	166
23	156	173	150	157	153	155
24	144	160	141	161	156	179
25	152	195	168	165	165	173
26	190	167	165	167	160	168
27	174	197	175	190	145	151
28	152	147	186	133	158	160
29	157	165	157	180	161	145
30	164	159	166	171	164	169



## APPENDIX - M

**RAW SCORES OF TWO EXPERIMENTAL GROUPS  
AND CONTROL GROUP IN RELATION TO  
LOCUS OF CONTROL**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	58	55	55	56	55	53
2	59	61	57	53	55	51
3	58	54	54	51	50	53
4	57	59	54	62	57	53
5	56	57	51	54	57	56
6	57	52	54	61	53	52
7	55	56	58	51	58	55
8	55	55	59	53	57	55
9	51	53	57	55	58	54
10	52	53	52	51	58	56
11	57	54	54	55	56	54
12	60	62	58	54	54	50
13	57	53	53	50	49	52
14	58	60	55	63	58	54
15	56	57	52	55	58	57
16	58	53	55	60	52	51
17	54	35	57	50	59	54
18	54	54	60	54	56	54
19	50	52	58	56	59	55
20	53	54	51	50	56	57
21	58	55	53	54	55	53
22	61	63	59	55	55	51
23	58	54	54	51	50	53
24	57	59	56	62	57	53
25	55	56	51	54	57	56
26	59	54	54	61	51	50
27	55	56	56	49	60	55
28	53	53	61	55	57	55
29	49	51	57	55	58	54
30	18	50	58	59	57	56



**APPENDIX - N**  
**RAW SCORES OF TWO EXPERIMENTAL GROUPS**  
**AND CONTROL GROUP IN RELATION TO**  
**CONCENTRATION**

S.No.	SURYABHEDANA PRANAYAMA GROUP		SHITALI PRANAYAMA GROUP		CONTROL GROUP	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	96	92	87	82	102	99
2	88	85	98	91	92	89
3	102	97	92	86	75	74
4	86	79	110	103	83	81
5	93	87	105	96	78	77
6	116	99	93	87	112	113
7	105	98	82	76	95	95
8	89	91	86	82	82	81
9	79	65	94	91	77	76
10	93	88	85	82	86	85
11	97	93	88	83	101	98
12	89	84	99	92	91	88
13	103	98	93	87	74	73
14	87	80	111	104	82	80
15	94	88	106	97	77	76
16	117	100	94	88	111	112
17	106	99	83	77	94	94
18	90	92	87	83	81	80
19	80	83	95	92	76	75
20	94	89	86	83	85	84
21	95	91	86	81	103	100
22	87	84	97	90	93	90
23	101	96	91	87	76	75
24	85	78	109	102	84	82
25	92	86	104	95	79	78
26	115	98	92	86	113	114
27	104	97	81	75	96	96
28	88	90	85	81	83	82
29	78	64	93	90	78	77
30	92	87	84	81	89	86



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